6. NIGHTCAP VILLAGE FLOOD STUDY

Cardno - 2006

Cardno
Engineering the Future

Nightcap Urban Village

Flood Study

29 June 2006
Job No. 3500/53

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NIGHTCAP URBAN VILLAGE
FLOOD STUDY

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EXECUTIVE SUMMARY

The proposed development, on Kyogle Road, Kunghur, is bordered on its southern edge by the Tweed River. The site is undulating in its northern limits, but includes areas of level ground adjacent to the watercourse. This report describes the detailed flood study undertaken to predict the flood levels applicable to the site.

Peak flow rates for the Tweed River through the site were estimated using standard methods for New South Wales (see Section 2) after having determined the catchment area. Cross sections were obtained from a detailed topographical survey of the site, and input into the HEC-RAS hydraulic modelling software.

The resulting flood levels vary according to local topography, and as the river level falls naturally through the site. These derived levels are displayed graphically on aerial photography and on site development plans, the latter indicating that the risk to residents and property is minimal providing that sensible design measures are employed.

Previous reports have shown that proposed development on some of the lower lying areas of the site could have been subject to flooding in the most extreme events. The Concept Plan has been amended in the light of these findings, reshaping or removing development zones out of the flood inundation area. The Village Housing zone in the south west of the site is an exception to this; in this case, levels will be raised using fill material, sufficient to preclude the risk of inundation.

1. INTRODUCTION

It is proposed to develop a site on Kyogle Road in the Kunghur area of north-eastern New South Wales to create a residential village. The site falls within the jurisdiction of Tweed Shire Council, and as the site is adjacent to the Tweed River, a flood study is required to determine the flood levels applicable to the site. This report details Cardno's advice in this regard.

As can be seen from Figure 1, the site is bounded by Kyogle Road to the south, and the southern extents lies within meanders of the Tweed River. The site, of over 45 hectares in area, is undulating in the north, but much of the southern area lies on level ground close to the river.

The site is currently characterised by pockets of woodland among open grassland. Development proposals include residential lots of varying density, and accompanying sports, recreation, hotel and commercial areas. Most of the proposed development is already positioned some distance from the river, a riparian zone having been identified which also forms a buffer between the site and Kyogle Road.

The Tweed River, as it enters the site, has a contributing catchment of over 3,726 hectares, originating in the hilly country several kilometres to the southwest. It flows from the west and leaves the site in the east, and falls approximately eight metres as it travels 1750 metres through the site.

For the analysis, the 100-year event was considered in accordance with the requirements of Tweed Shire Council Development Control Plan (DCP) 16.

2. HYDROLOGY

Peak discharges were calculated using the Rational Method, in accordance with *Australian Rainfall and Runoff* (Institute of Engineers Australia, 1987), after having established the catchment area (shown in Figure 2). Design rainfall intensities were accessed for the site using the AUSIFD software, and are reproduced below.

Table 1 Rainfall Intensity for Kunghur, NSW

Duration	Average Recurrence Interval			
	1 year (mm/hr)	10 year (mm/hr)	20 year (mm/hr)	100 year (mm/hr)
10 mins	91	160	181	231
30 mins	54	97	110	142
60 mins	36.9	67	77	99

The time of concentration (i.e. the time taken for rainfall to travel to the site under examination) is critical in assessing runoff from the catchment. As the site is rural in nature, the method recommended for Eastern New South Wales in *Australian Rainfall and Runoff* (Volume 1, Section 5.4.1) has been employed.

Once the time of concentration has been derived (a function of catchment area) a series of modifications to the rational method are followed to account for regional differences, which results in an estimated design flood magnitude. In this case, the 100-year flow is estimated to be 426 m^3/s. Full details of the calculations are given in Appendix A.

3. HYDRAULIC MODEL

3.1 HEC-RAS Model Setup

HEC-RAS is an industry-standard one-dimensional hydraulic model used to perform hydraulic calculations for constructed and natural waterways. A HEC-RAS model was created using 21 cross-sections derived from a detailed survey, which crossed the channel and continued on to higher ground. Where these sections did not extend far enough (where they meet the road at the southern edge of the site, for example) they were extended using available contour data. The locations of the cross sections are shown in Figure 3.

Manning's n values will vary between the channel, the immediate vicinity of its banks, and the wider floodplain. Manning's numbers have been estimated to be 0.025 for the channel, 0.15 for the thick vegetation at the top of the banks, and 0.05 for the wider grassed floodplains.

In previous reports, development zones were found to infringe on the derived flood inundation area. The affected zones have now been reshaped or removed to preclude the possibility of flooding. An exception to this process occurs for the Village Housing zone in the southwest of the site. Ground levels in this area will be raised using fill material, and this has been modelled by the use of ineffective flow areas in Sections 17 to 19 (positioned where the cross section meets the development zone and set at a theoretical height sufficient to preclude overtopping).

3.2 Flood Inundation Levels

The model provides maximum water levels at each section for the 100-year event. The flood extent is shown graphically in Figure 3, showing the area of inundation over aerial photography, and in Figure 4, showing the inundation in relation to the Structure Plan. By comparing water levels with ground levels across the proposed lots, it can be concluded that the lots are free from flooding.

Table 2 Flood Inundation Levels

Section	100yr level (m AHD)	Section	100yr level (m AHD)
22	82.47	**11**	77.15
21	80.17	**10**	77.11
20	79.29	**8**	75.57
19	79.20	**7**	75.55
18	79.34	**6**	74.44
17	78.56	**5**	74.43
16	78.54	**4**	74.13
15	77.69	**3**	74.24
14	77.49	**2**	72.86
13	77.62	**1**	72.23
12	77.44		

4. CONCLUSION

It is proposed to develop an area at Kunghur, north of the Tweed River, for mixed use development. The threat of inundation to property in the 100-year design rainfall event has been assessed.

A HEC-RAS model of the site was set up using Rational Method calculations adapted for eastern New South Wales, based on a topographical survey of the area and 21 surveyed cross-sections.

Previous reports have shown that proposed development on some of the lower lying areas of the site could have been subject to flooding in the most extreme events. The Concept Plan has been amended in the light of these findings, and this updated report concludes that the proposed development is free from flood inundation.

FIGURES

Figure 1 **Locality Plan**

Figure 2 **Catchment Area**

Figure 3 **100-Year Flood Extent & Cross Section Locations**

Figure 4 **100-Year Flood Extent Relative to Structure Plan**

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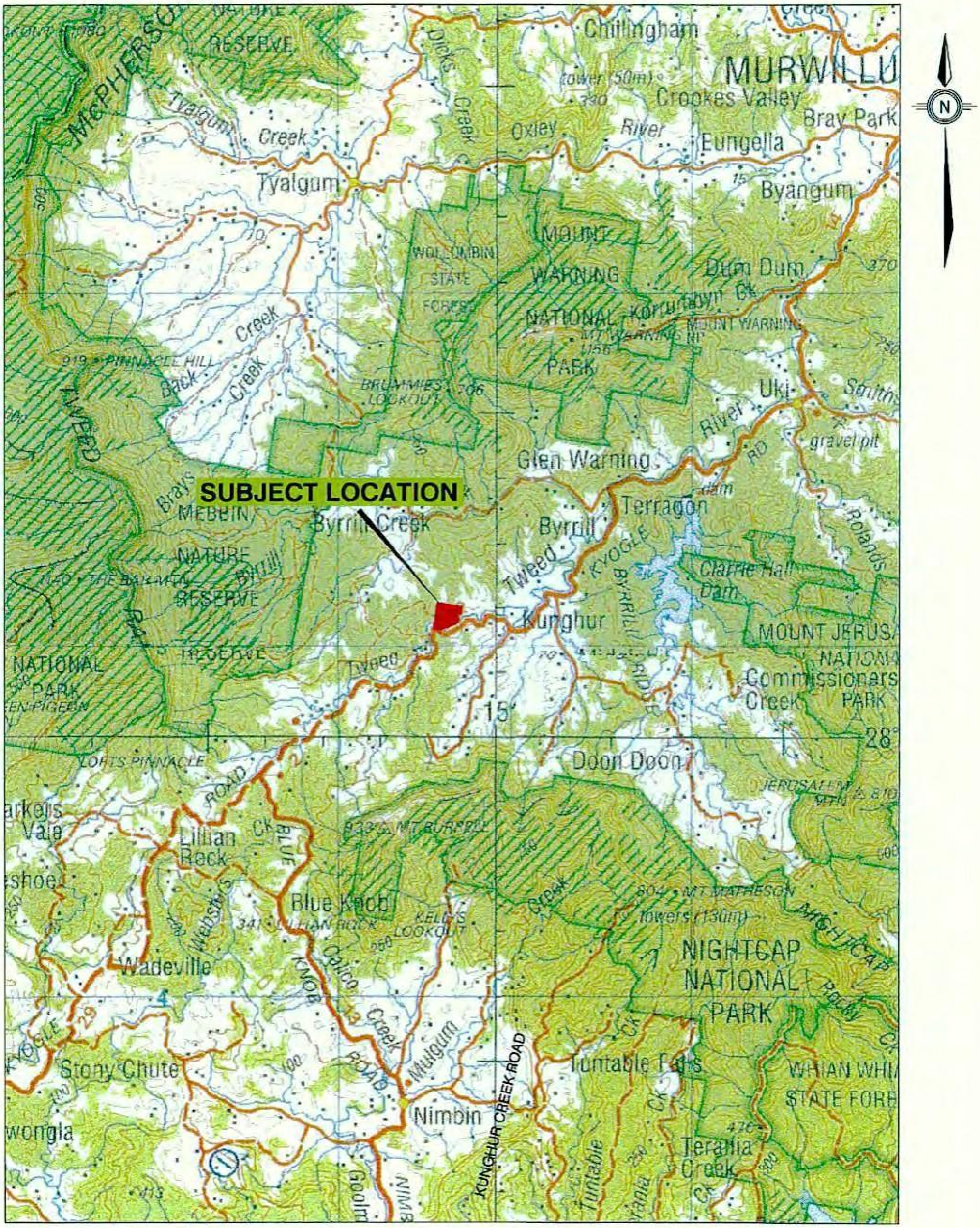

1.5 0 1.5 3.0 4.5 6.0 7.5km
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FIGURE 1
LOCALITY PLAN

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Rev: Orig. Date: 10 February 2006

Project No.: 3500/53

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CAD FILE I:\3500-53\ACAD\Flood Study\Figure 1 - Locality Plan.dwg
XREF's. xr-Cadastre_study_area MGA94, xr-NSW Topo Maps

PRINT DATE 20 March, 2006 - 4:07pm

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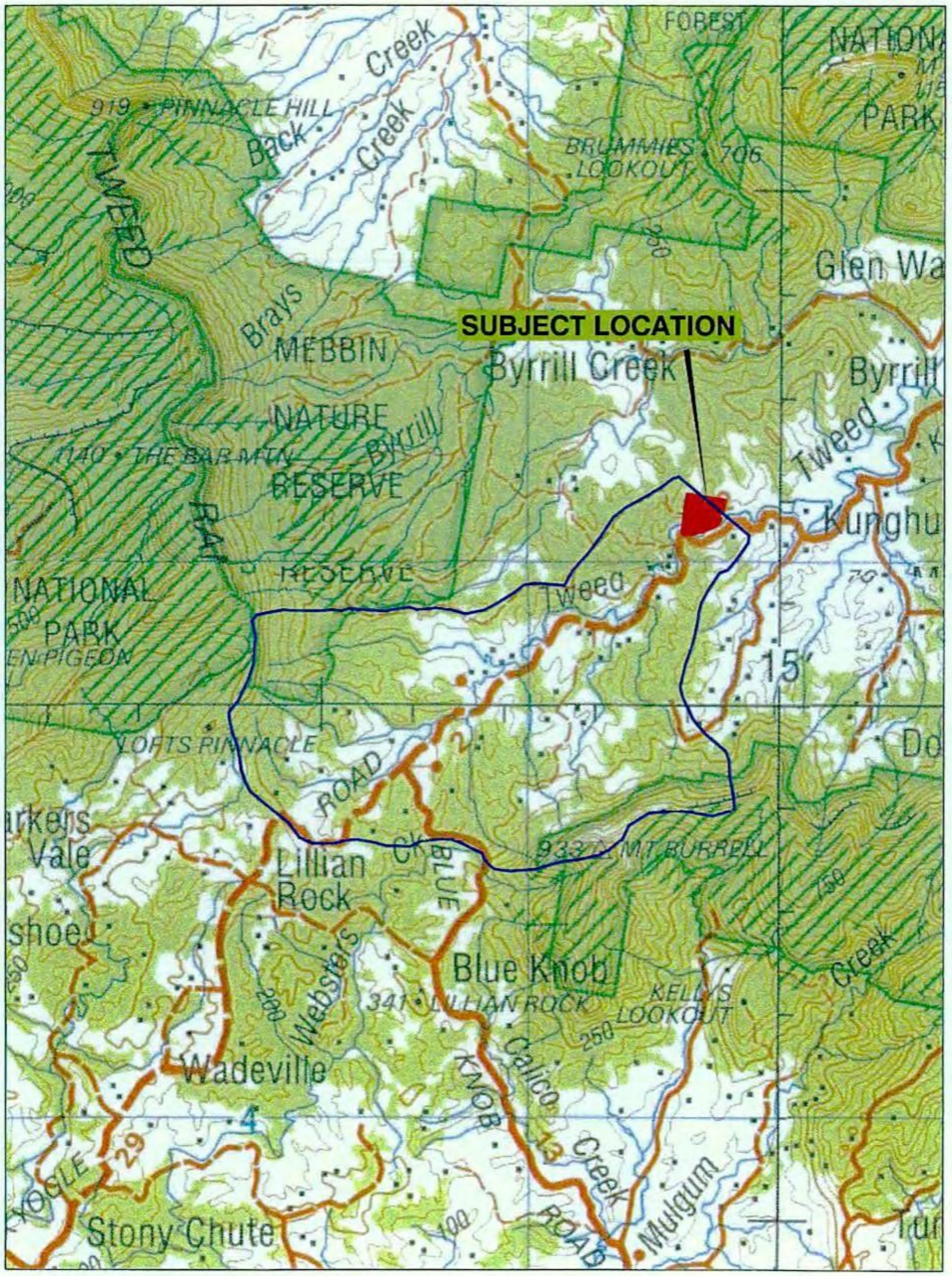

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FIGURE 2
CATCHMENT AREA

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Rev: A Date: 29 June 2006

Peter Van Lieshout
CAD FILE I:\3500-53\ACAD\Flood Study\Figure 3A - 100 Year Flood Extent.dwg
XREFs: xr-Aerial Ortho QASCO, xr-Contours QASCO

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FIGURE 3
100 YEAR FLOOD EXTENT & CROSS SECTION LOCATIONS

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PRINT DATE 27 July, 2006 - 3:10pm

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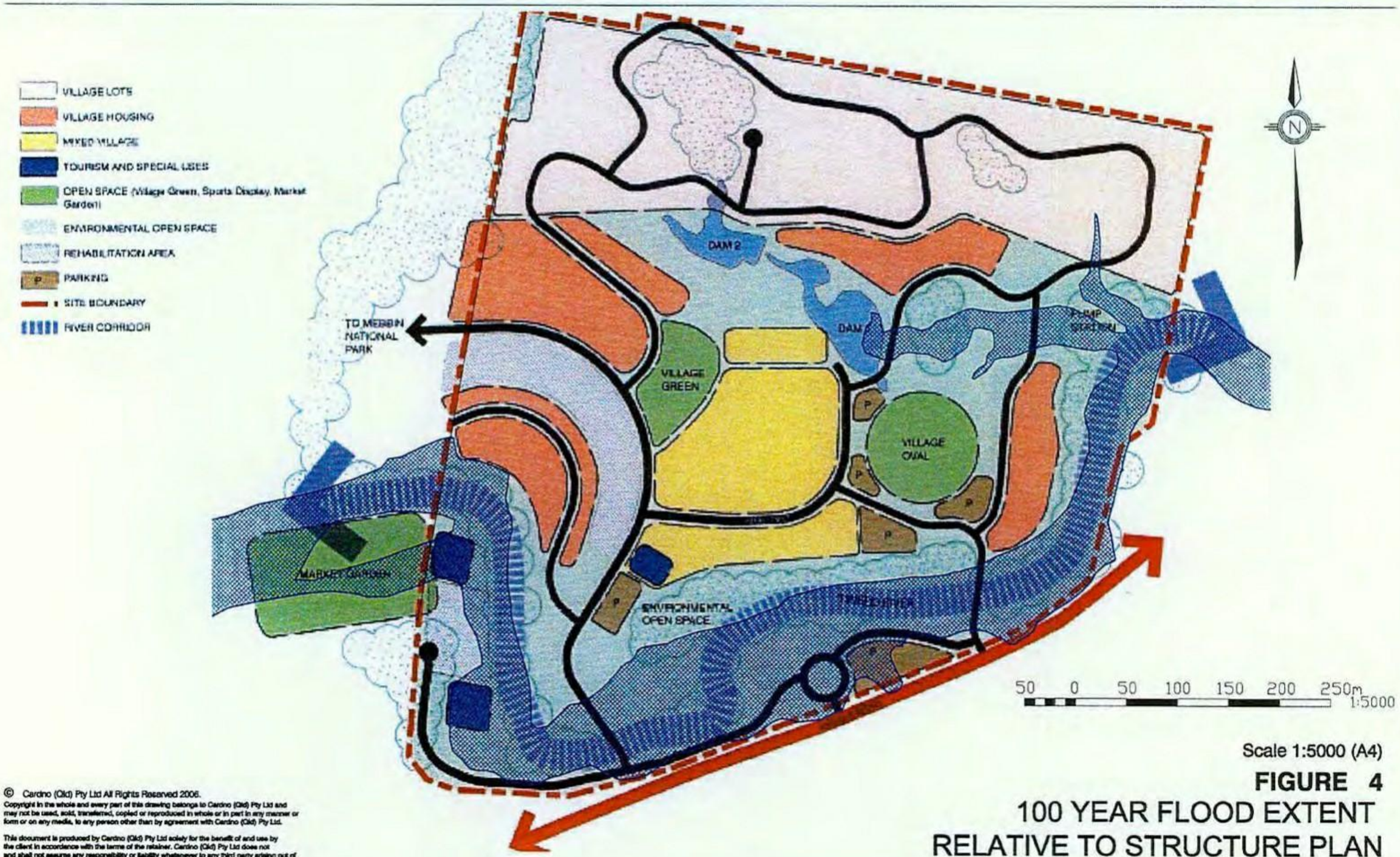

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FIGURE 4

100 YEAR FLOOD EXTENT
RELATIVE TO STRUCTURE PLAN

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Rev: 1 Date: 29 June 2006

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APPENDIX A

Rainfall and Runoff Calculations (Summary)

From Australian Rainfall and Runoff, Volume Two, Section 5.4.1a

i. determine critical duration

Catchment area = 37.26 km^2

t_c = 0.76 . A . 0.38 = approx 3 hrs, or 180 mins

ii. design rainfall intensity

from AusIFD = 58mm

iii. runoff coefficient C_{10}

from fig. 5.1 = 60% (or east of line) or 0.6

iv. frequency factor, FF_y

FF_{100} from table 5.1 = 2.45 – [(0.588 . $I_{12.50}$) / $I_{12.2}$]

= 2.45 – [(0.588 .25.4) / 118] = 1.184

$C_y = C_{10}$ x FF_y = 0.6 x 1.184 = 0.71

v. design flood magnitude

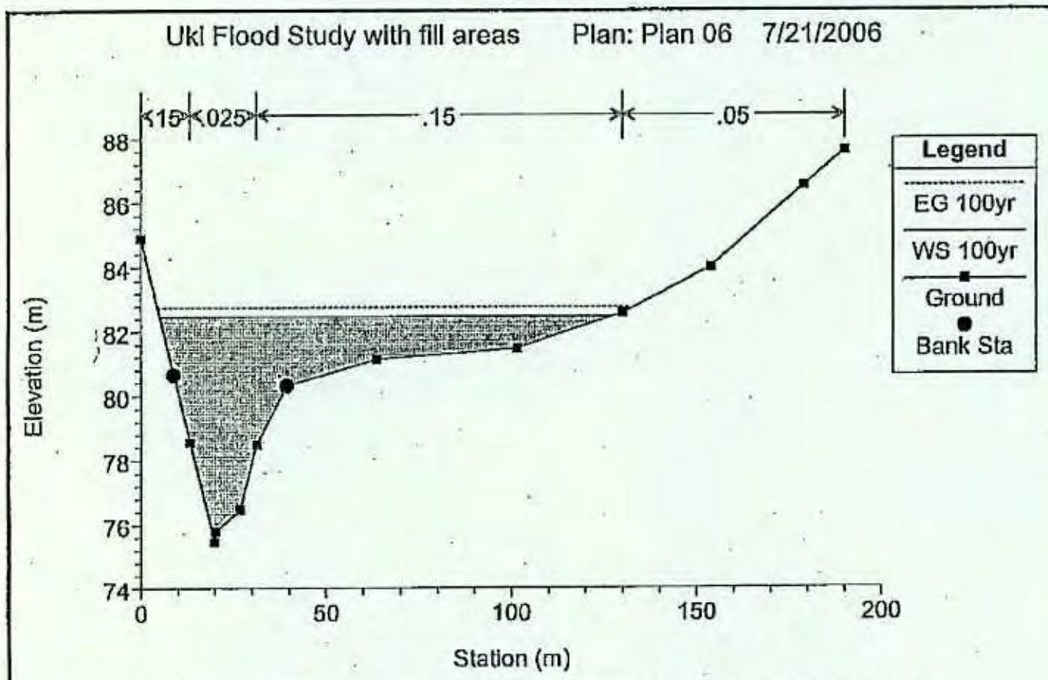
Eqn. 5.1 = 0.278 . C_y . $I_{tc,y}$. A

= 0.278 . 0.71 . 58 . 37.26

= 427 m^3/s

APPENDIX B

HEC-RAS Cross Sections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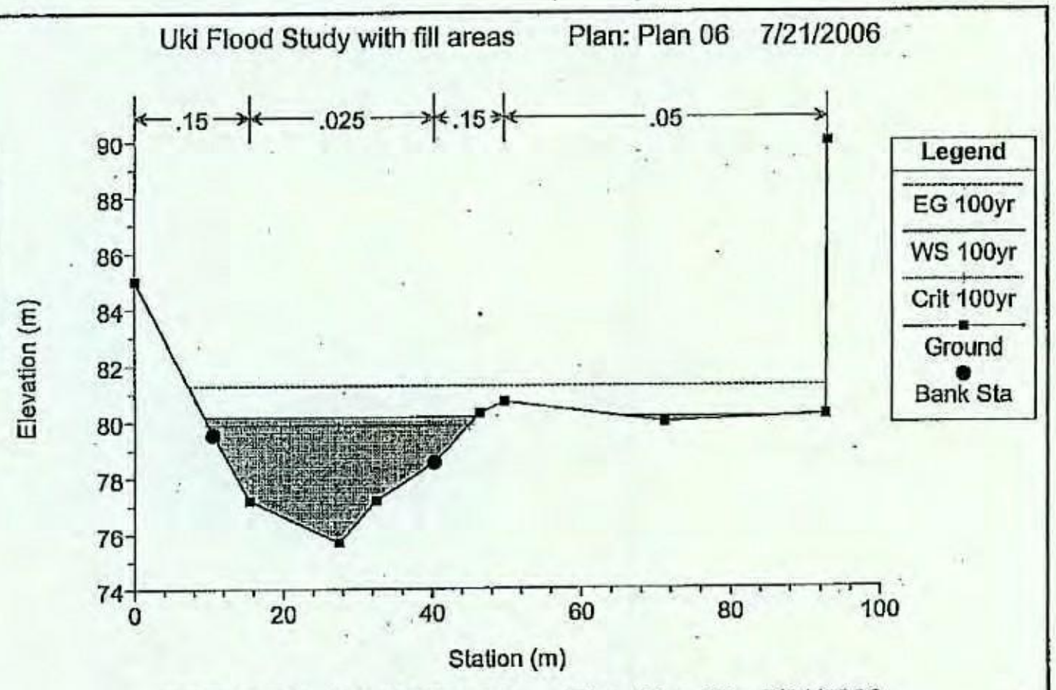
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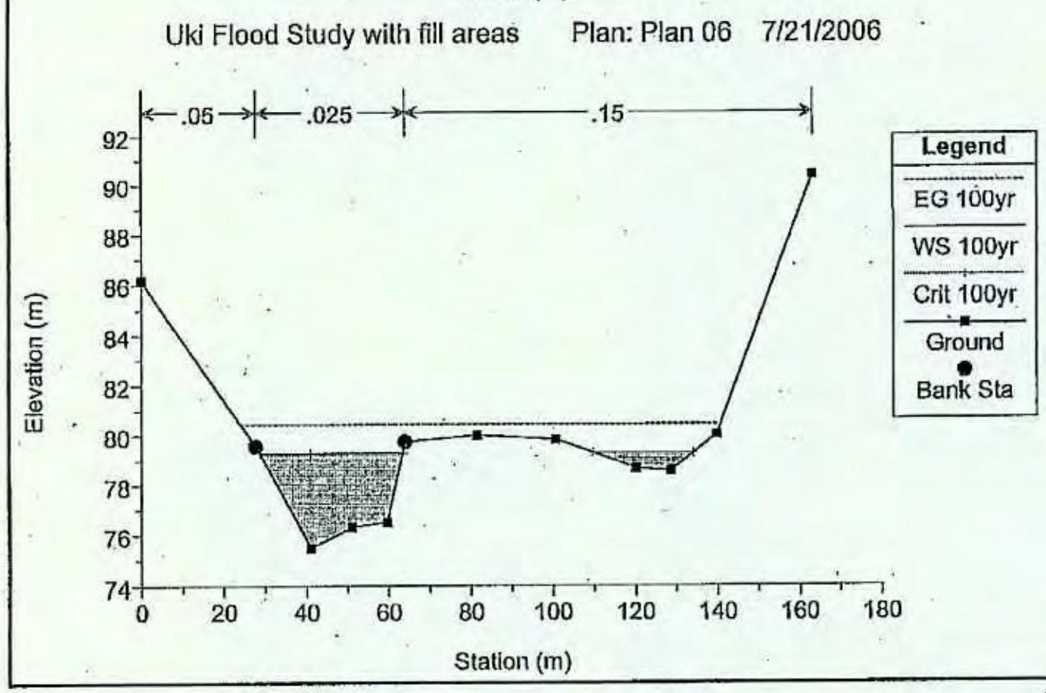
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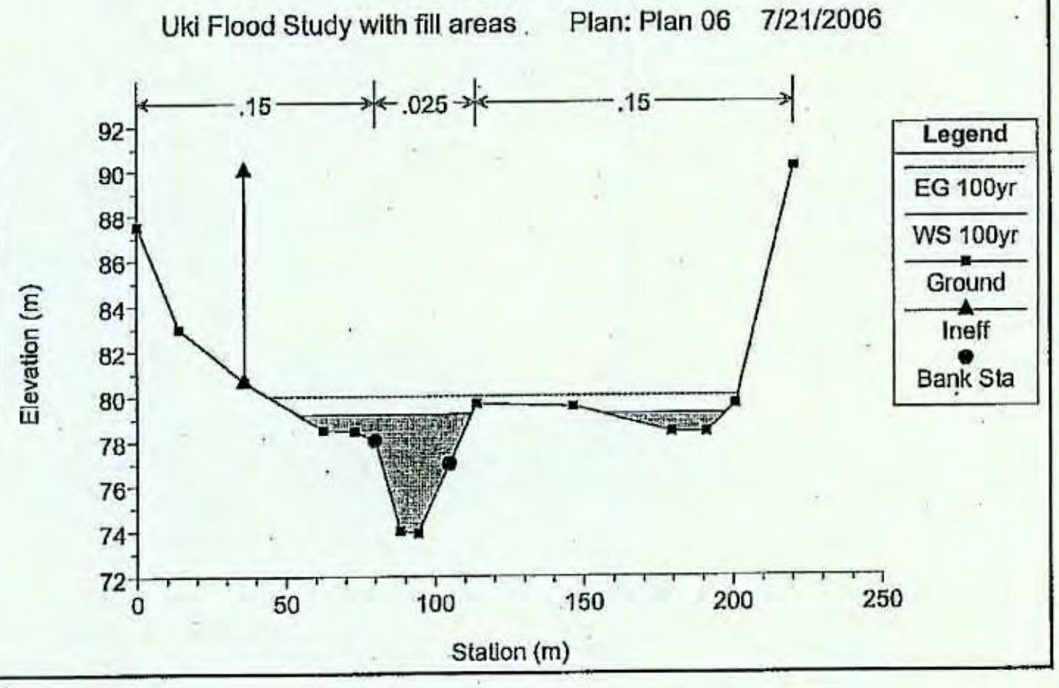
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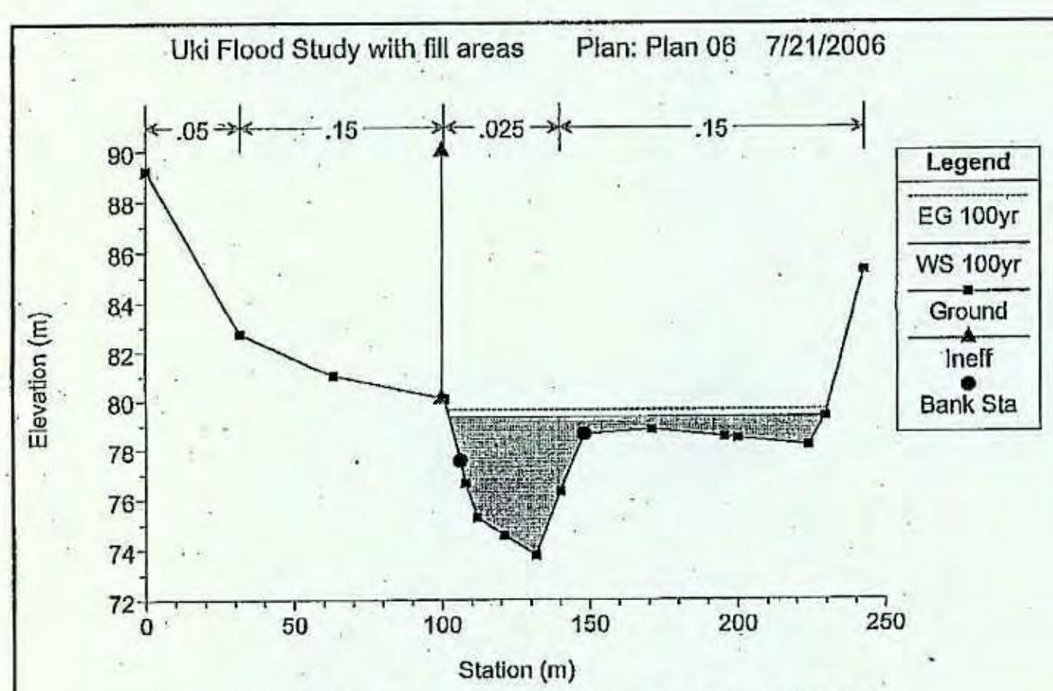
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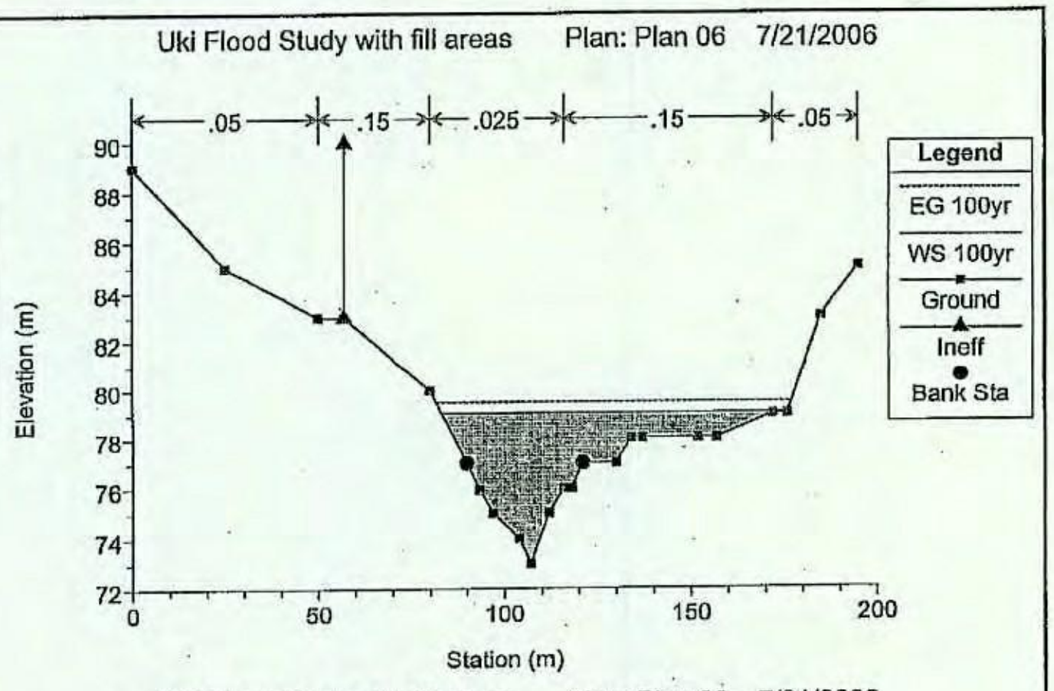
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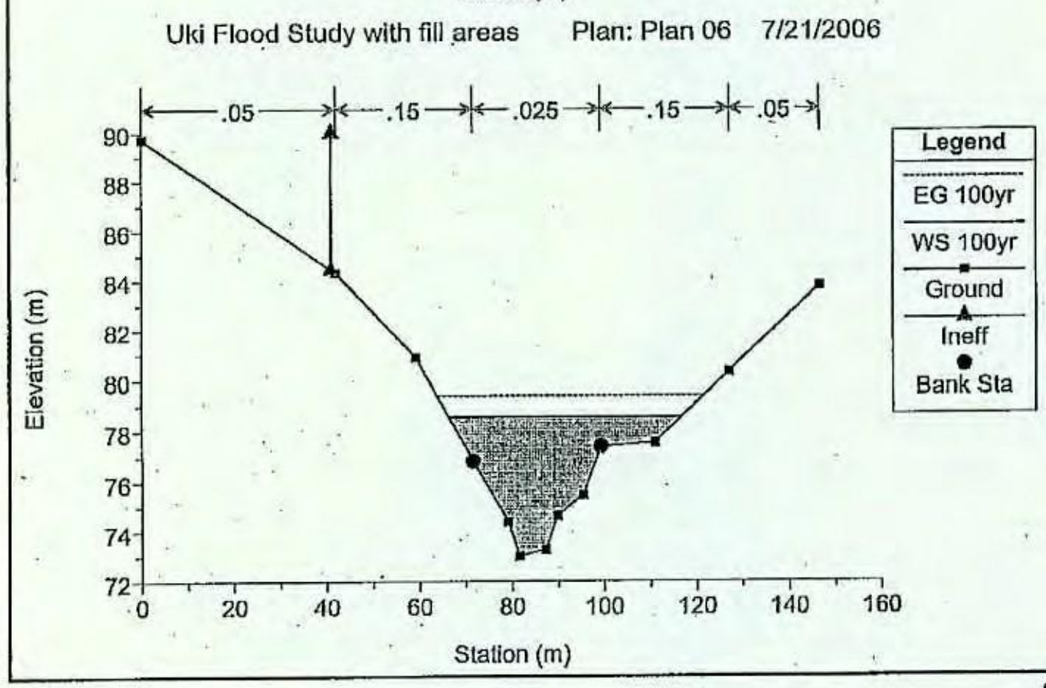
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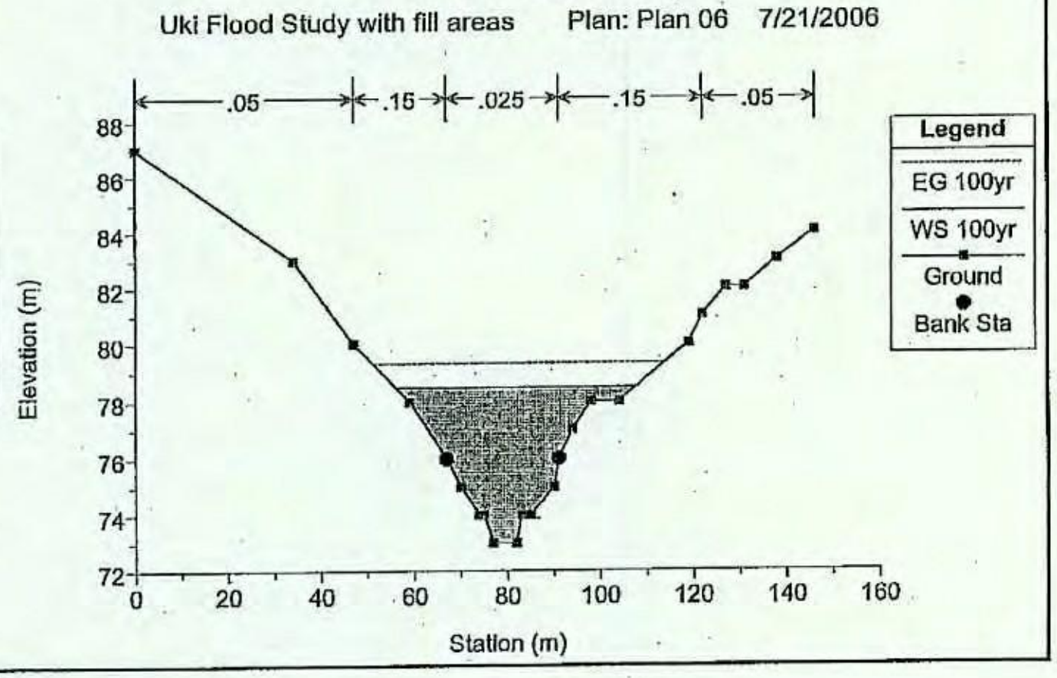
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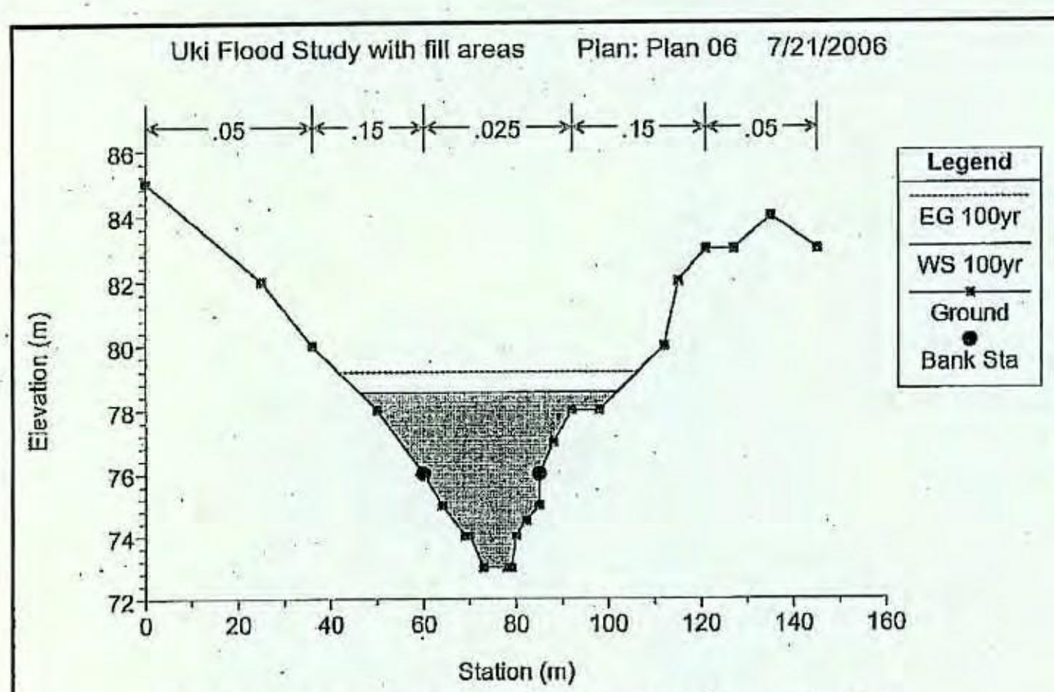
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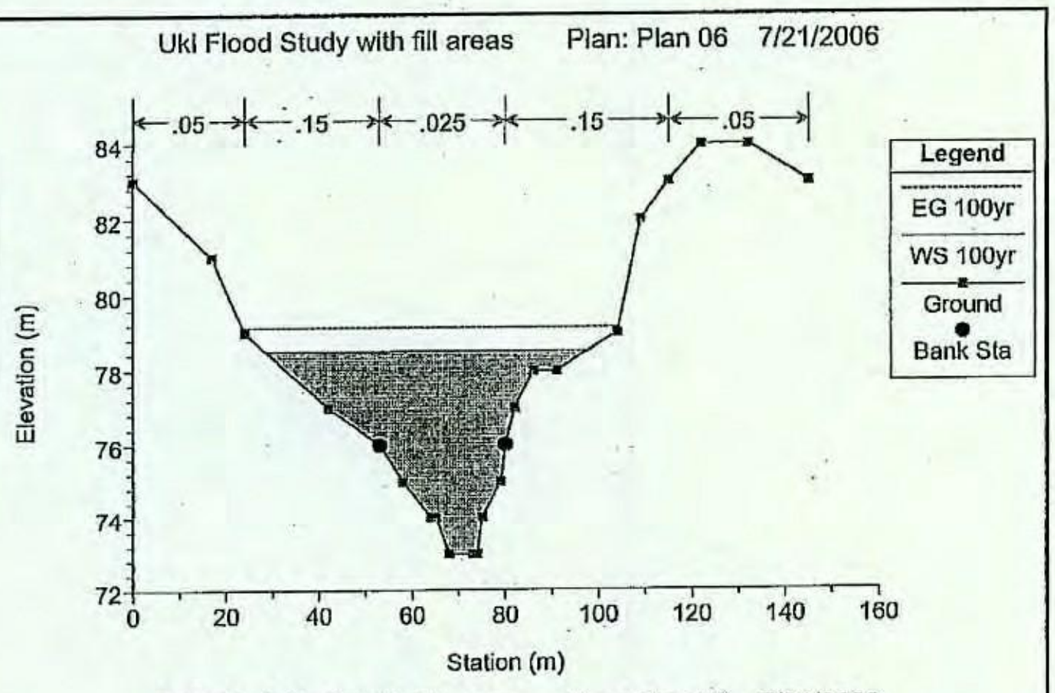
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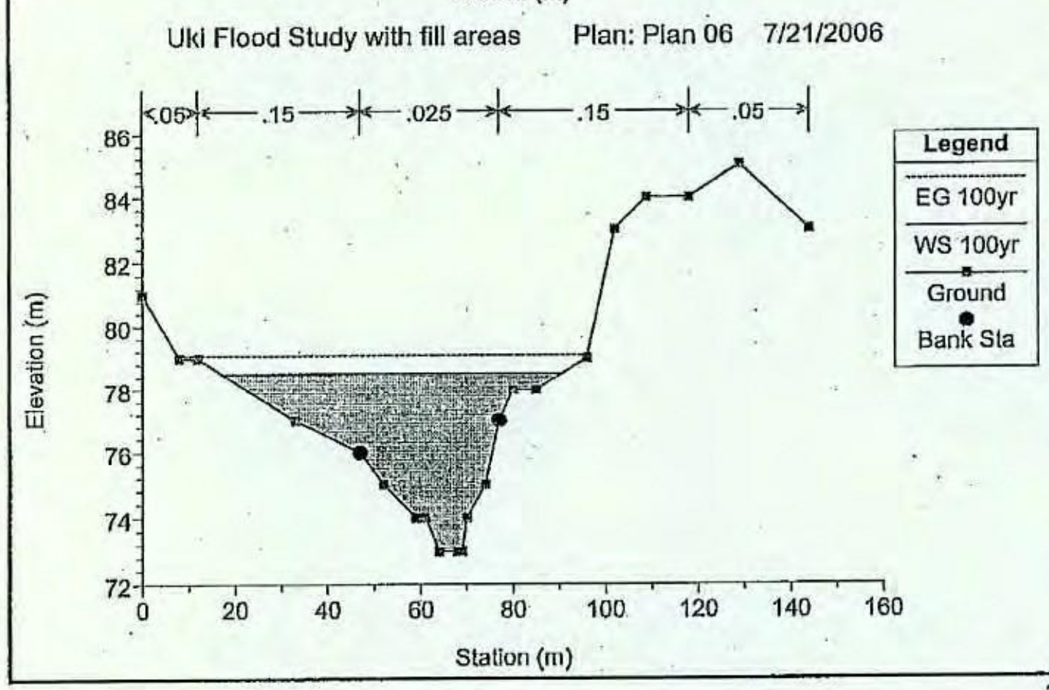
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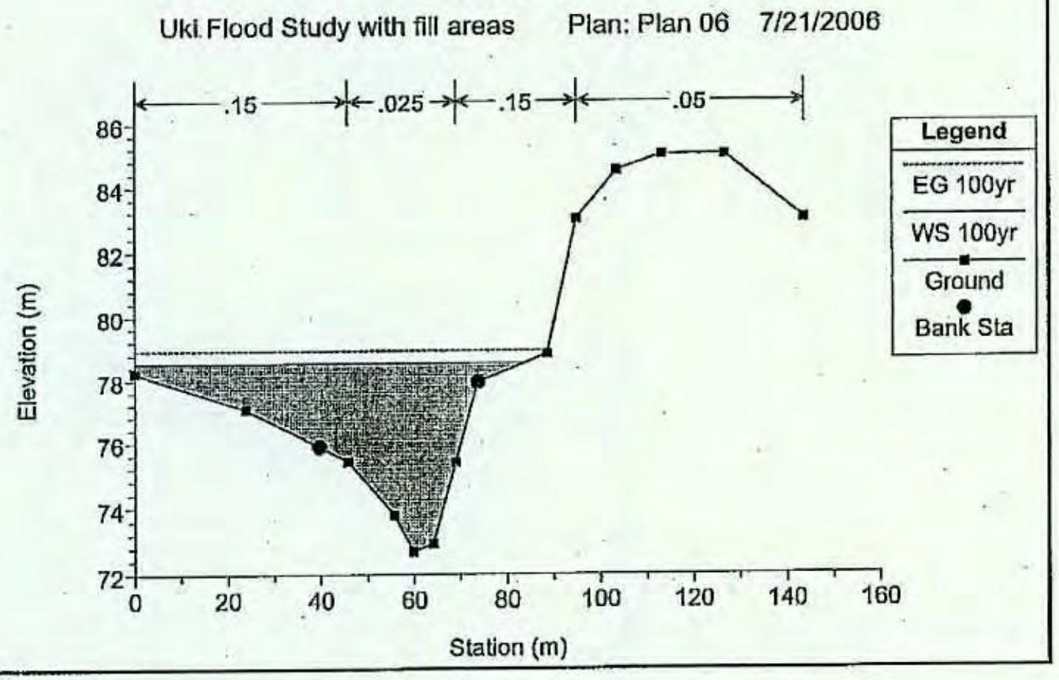
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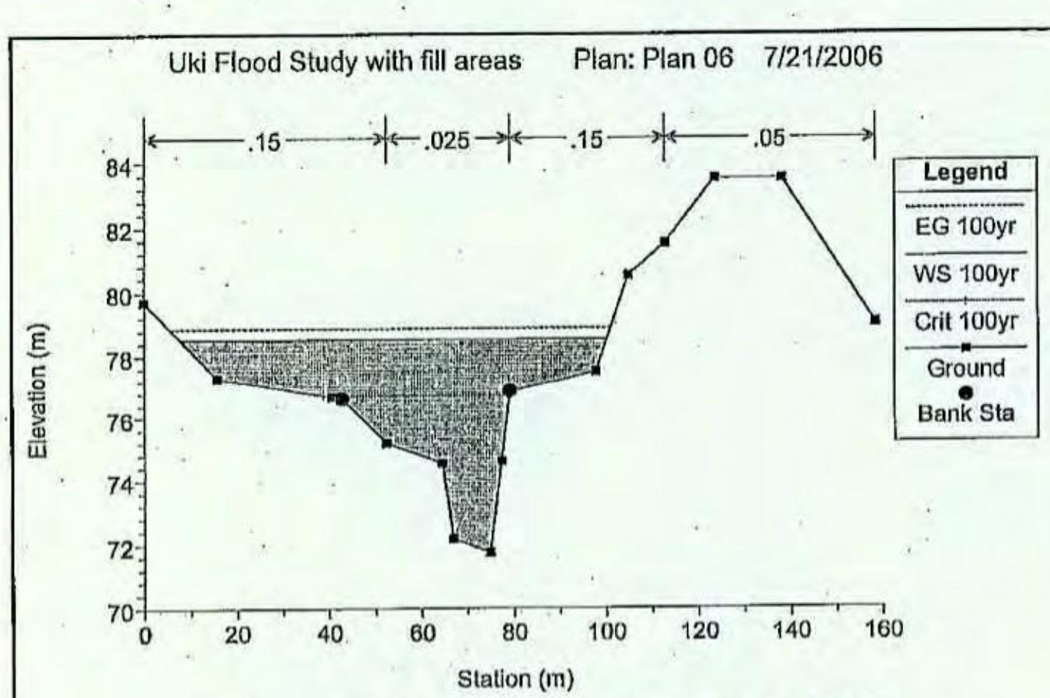
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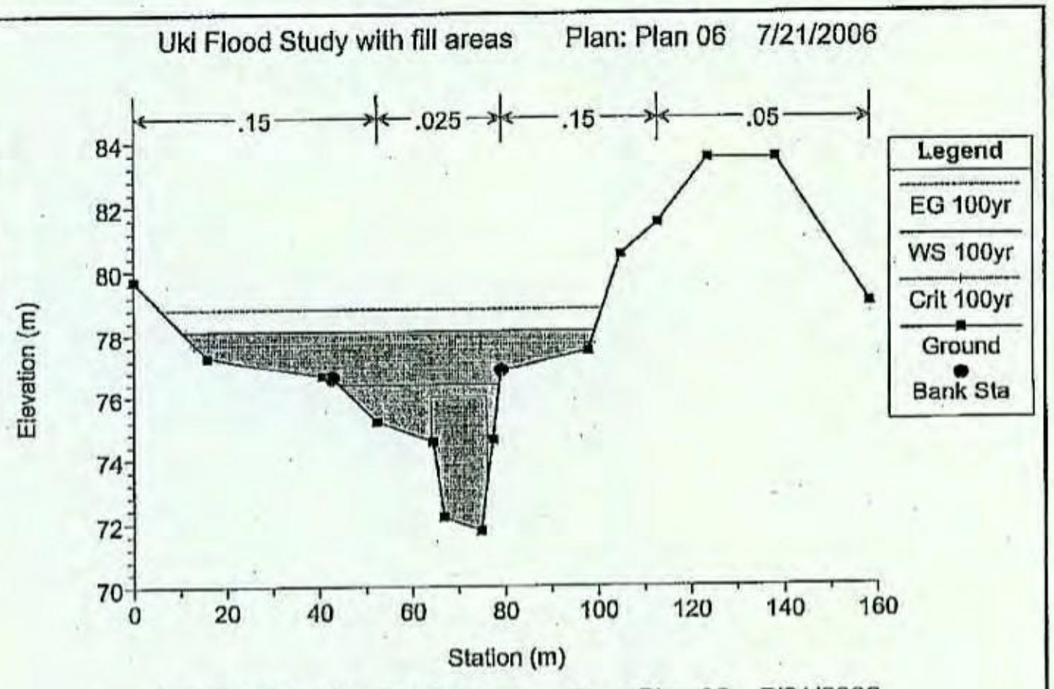
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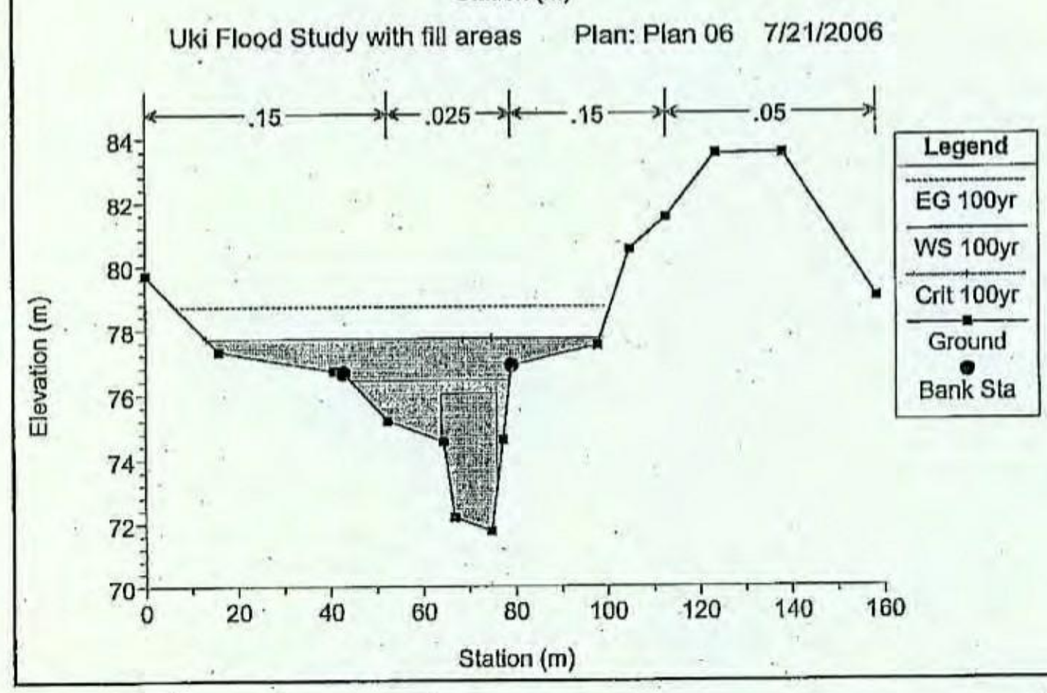
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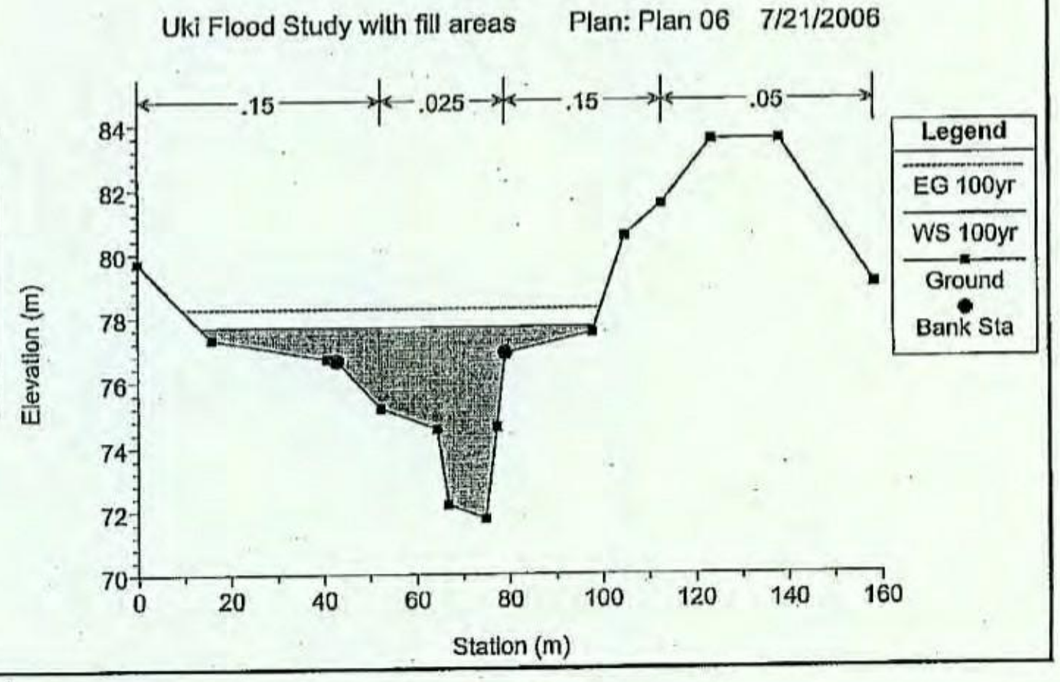
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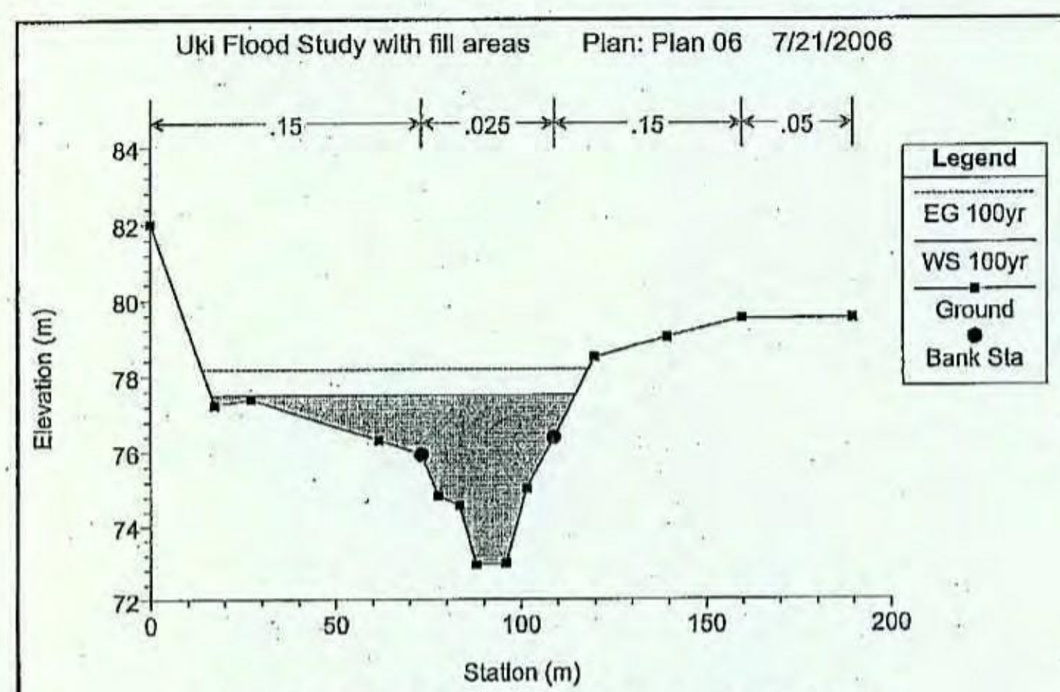
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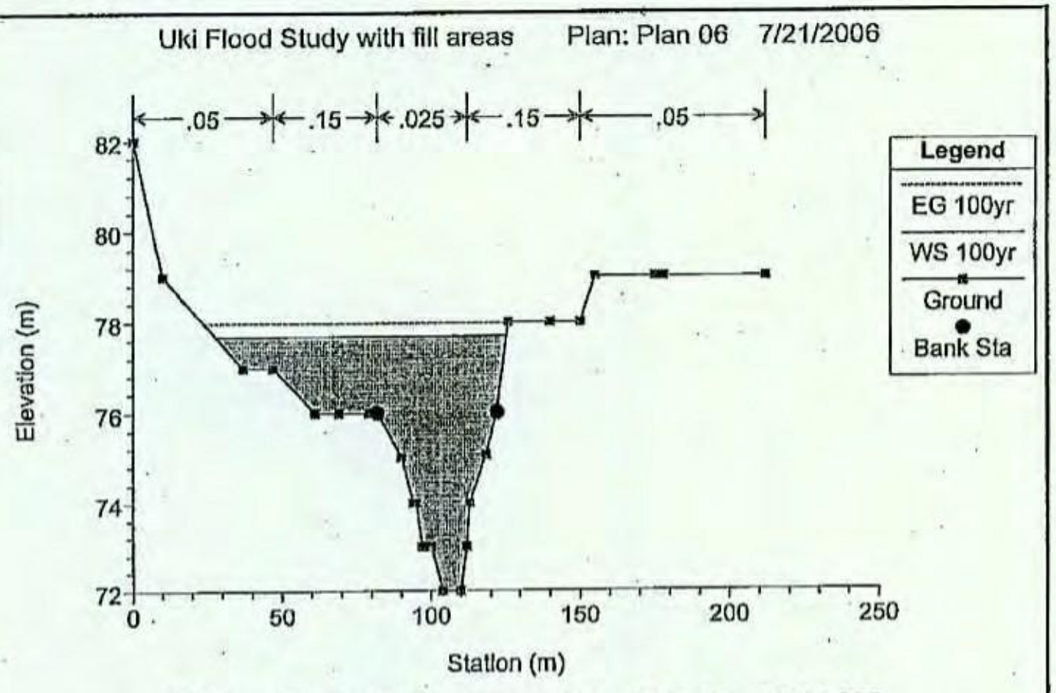
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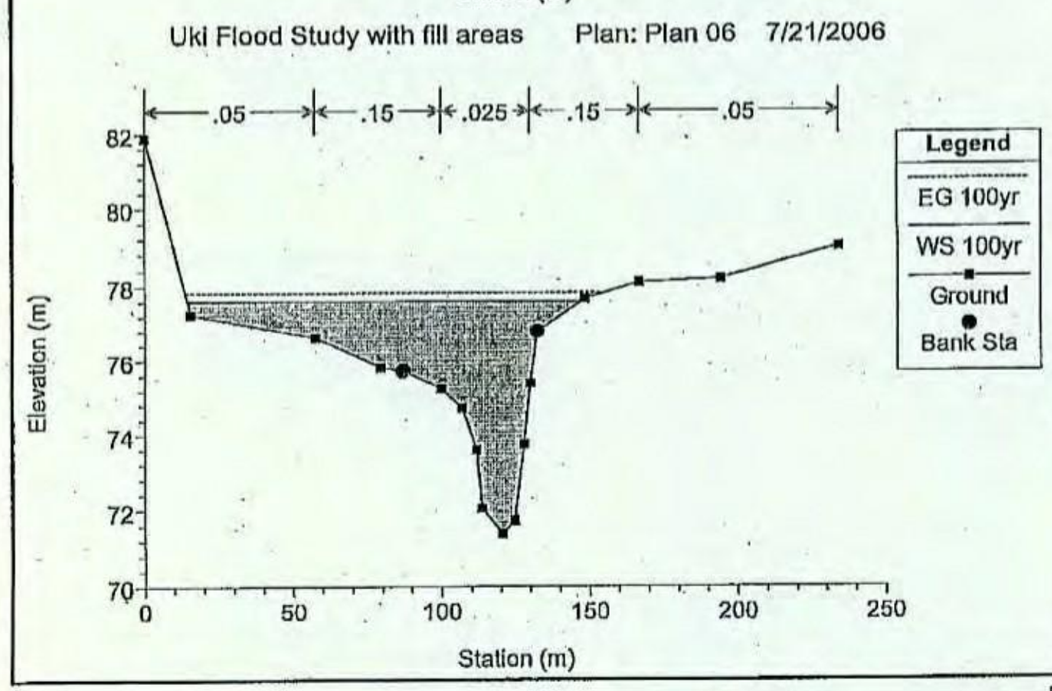
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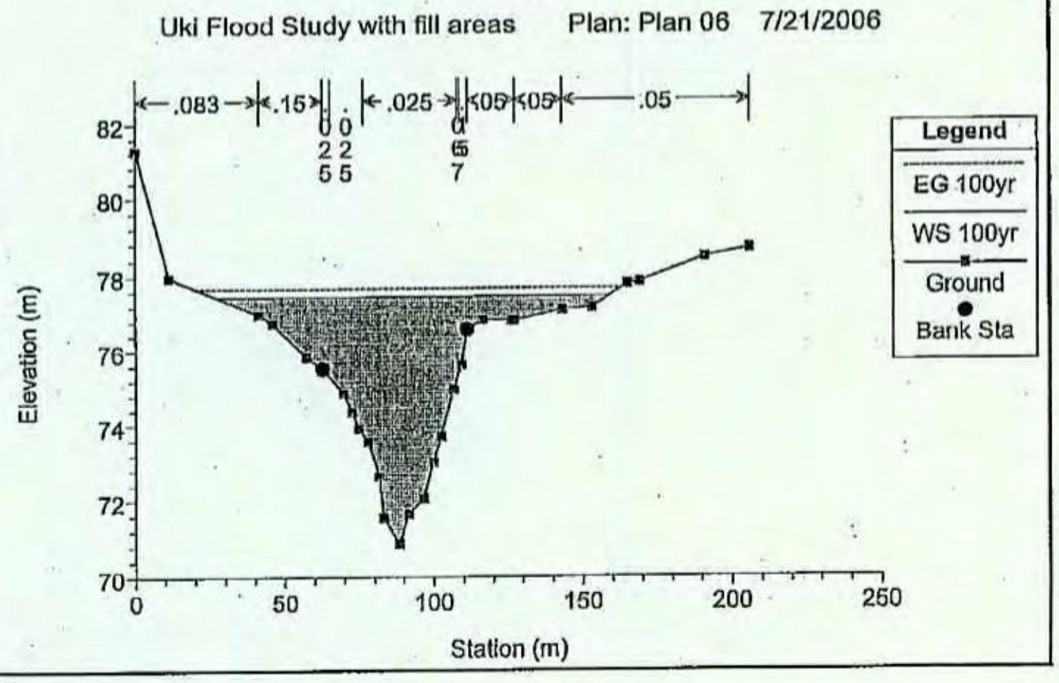
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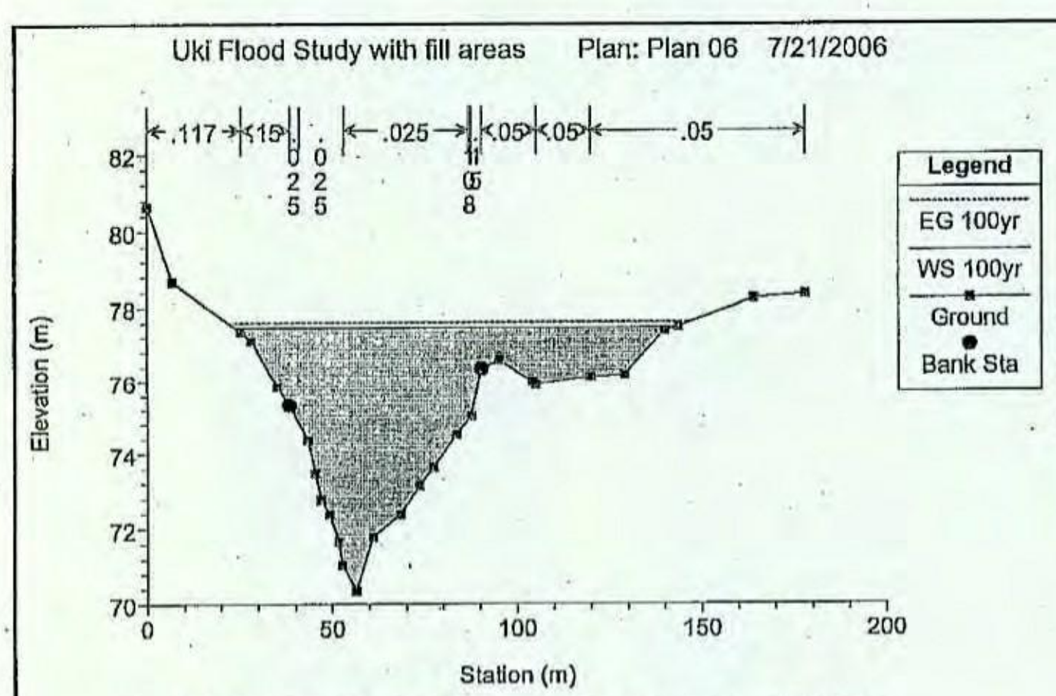
Elevation (m)
Station (m)
Legend
EG 100yr
WS 100yr
Ground
Bank Sta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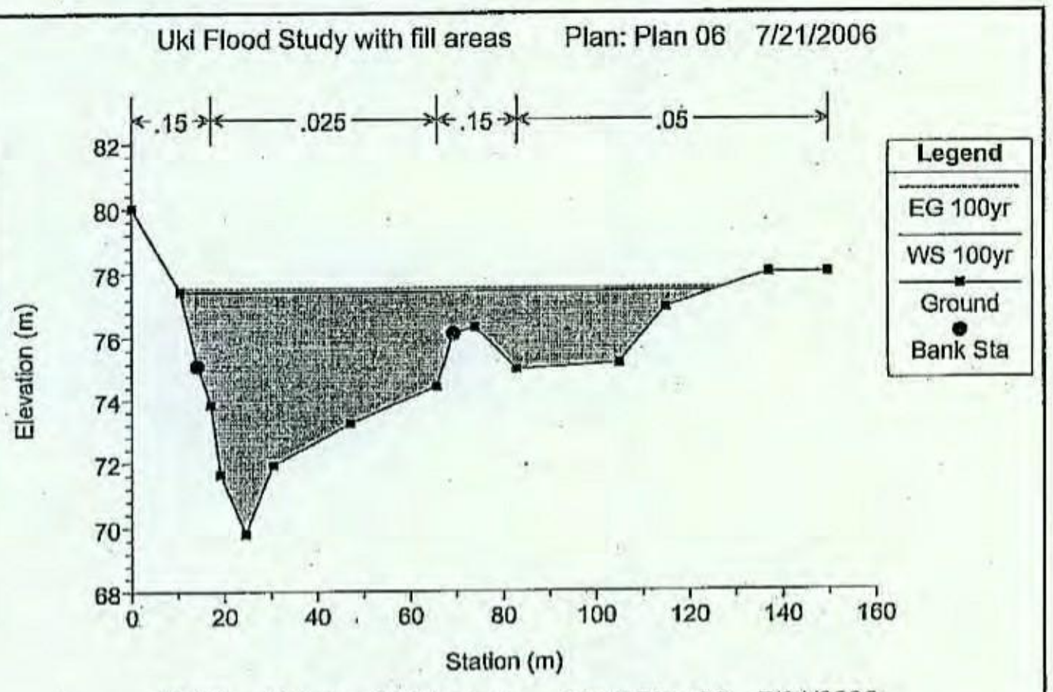
Station (m)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Elevation (m)
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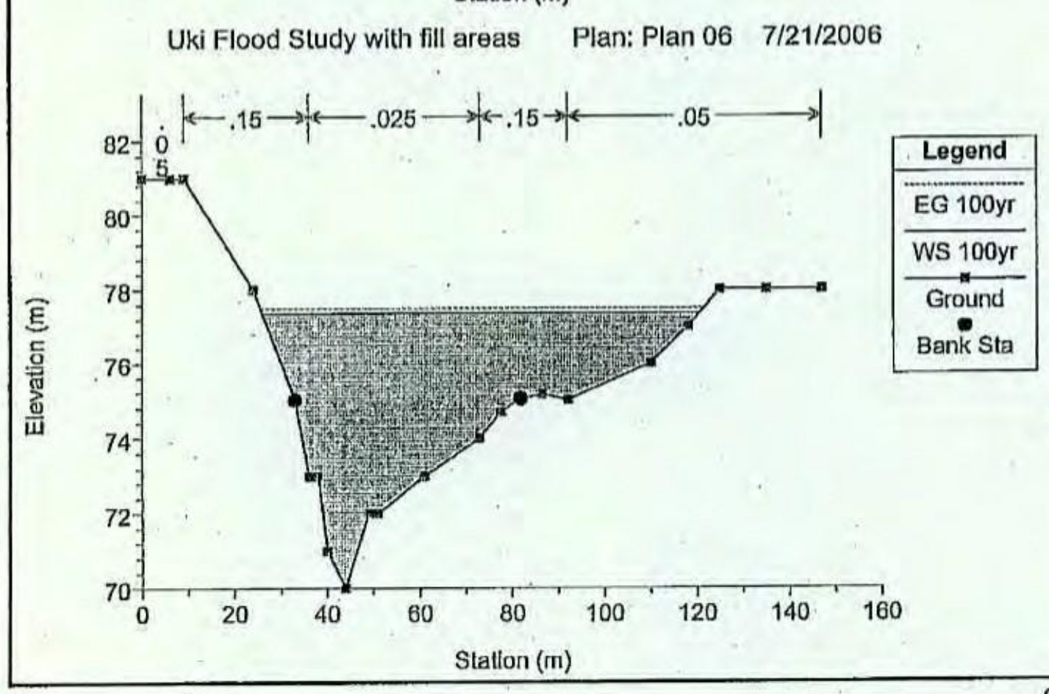
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Elevation (m)
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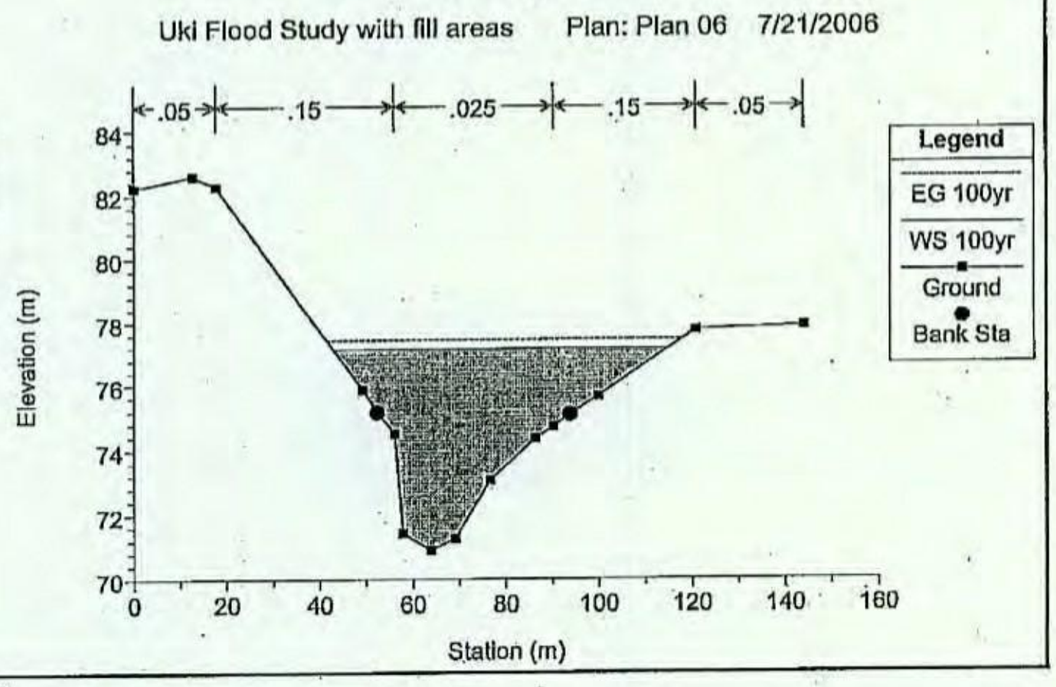
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Elevation (m)
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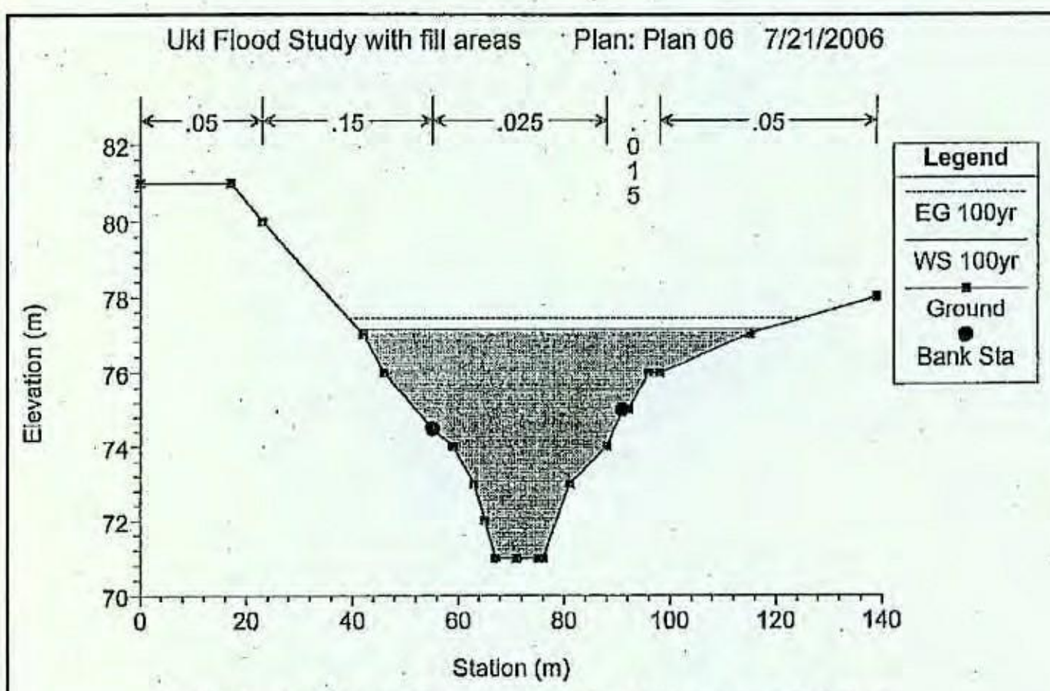
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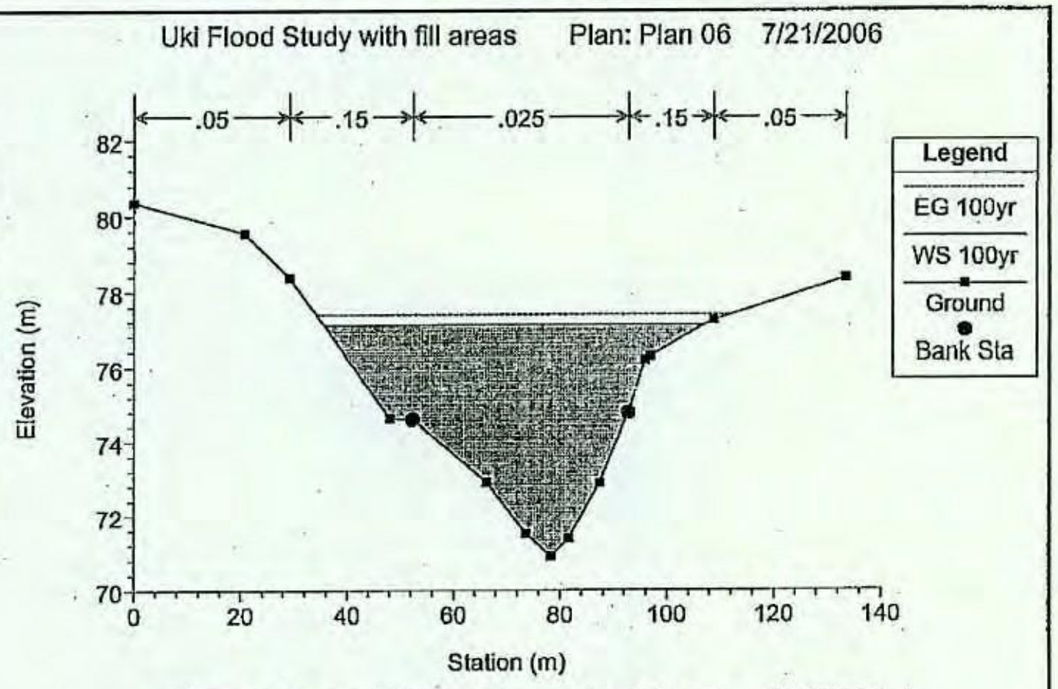
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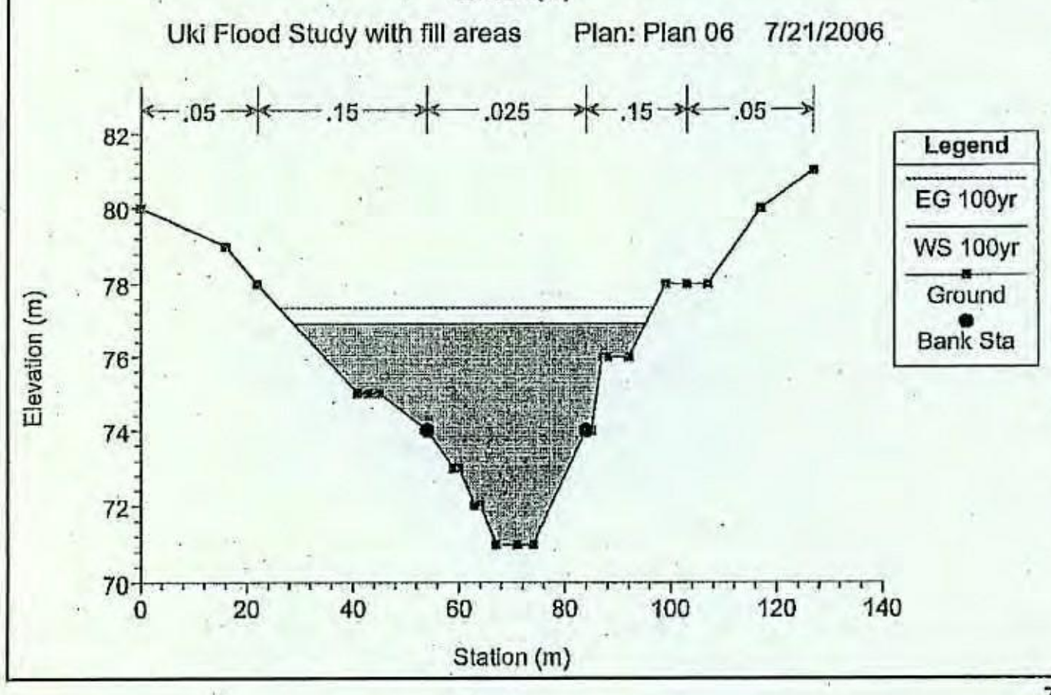
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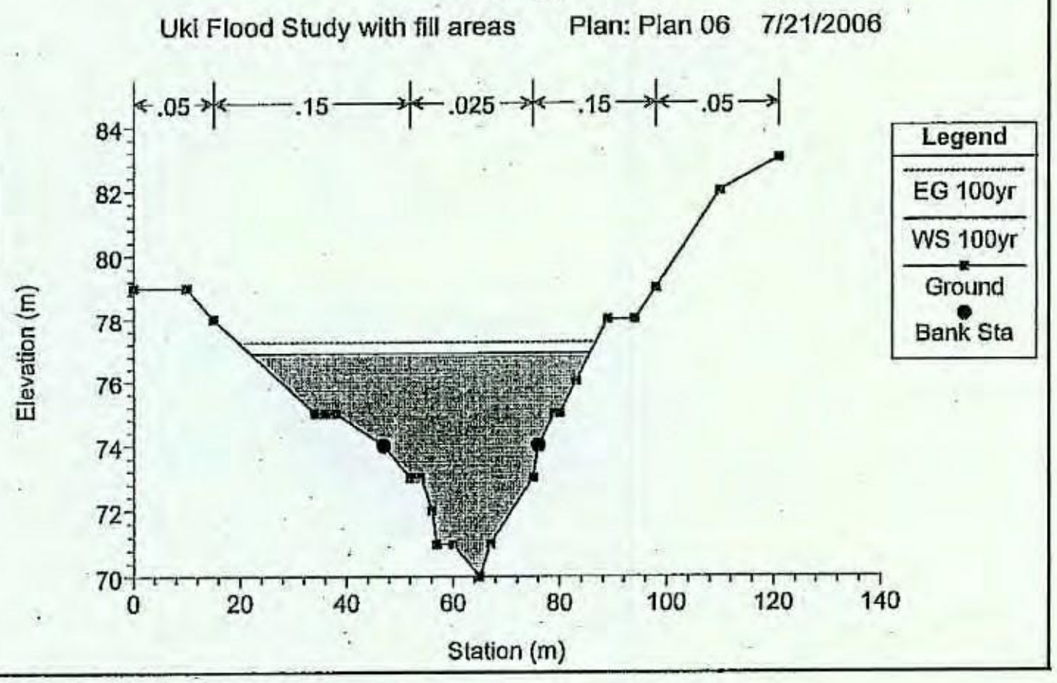
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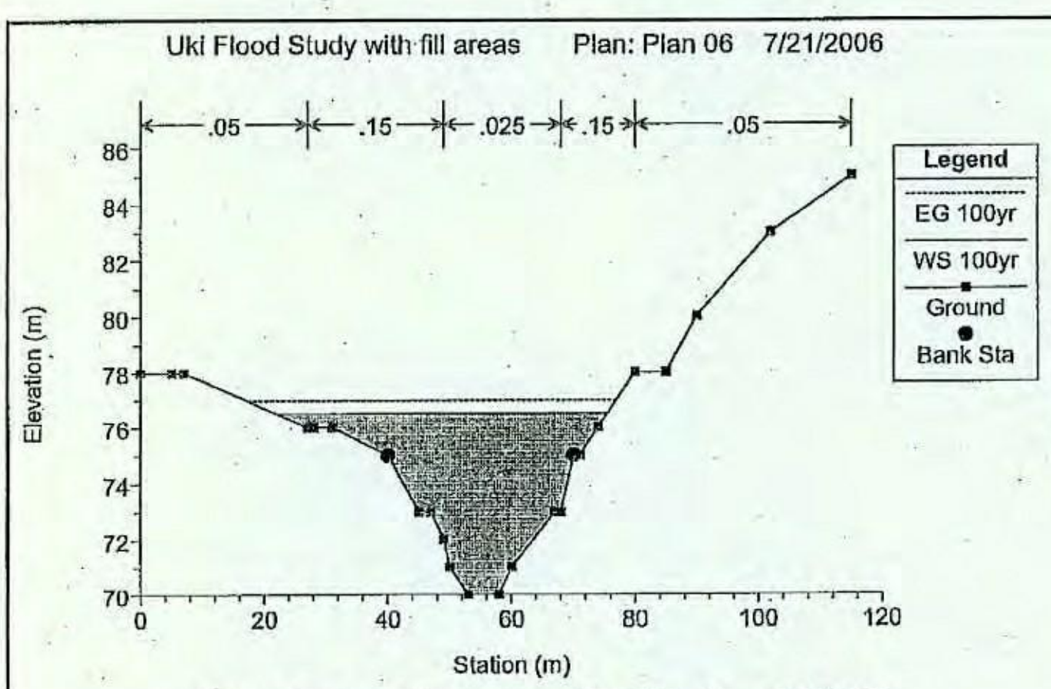
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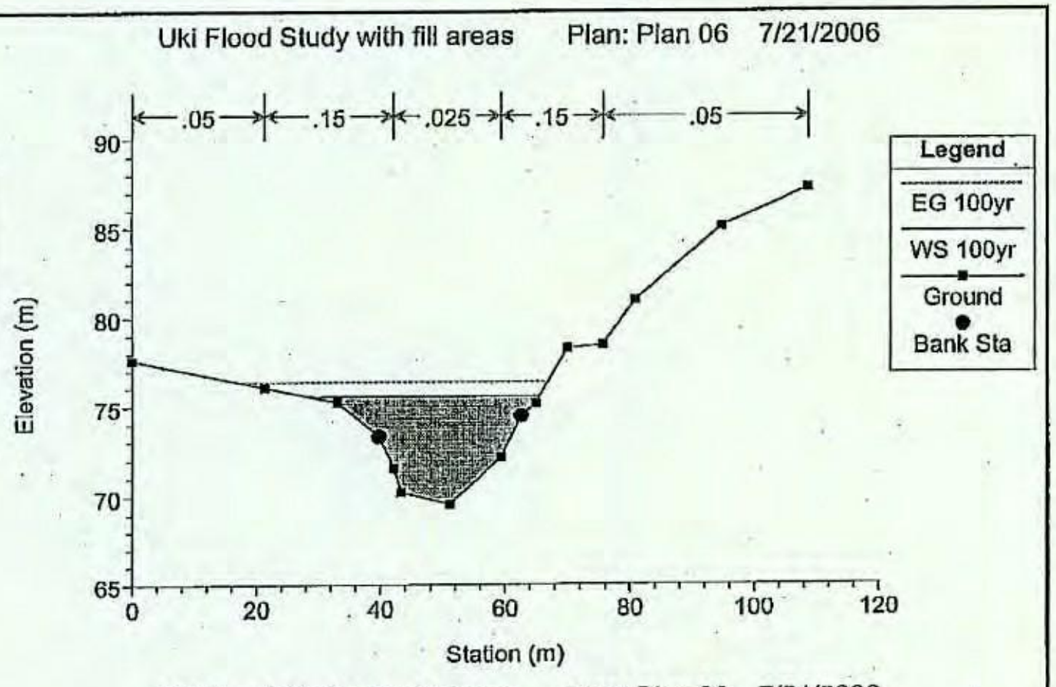
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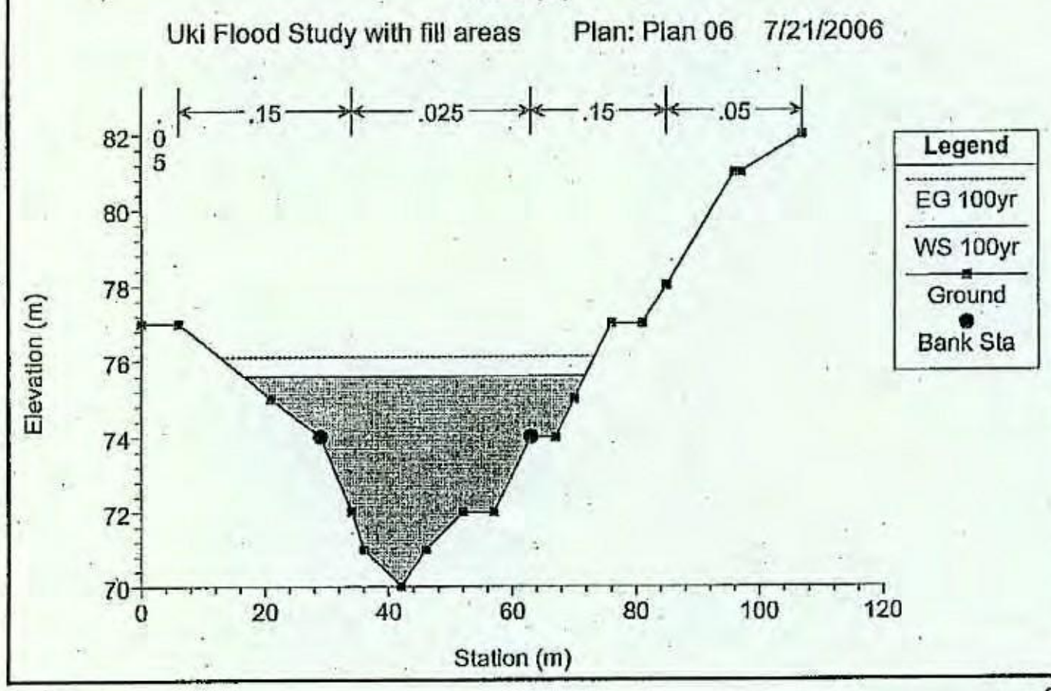
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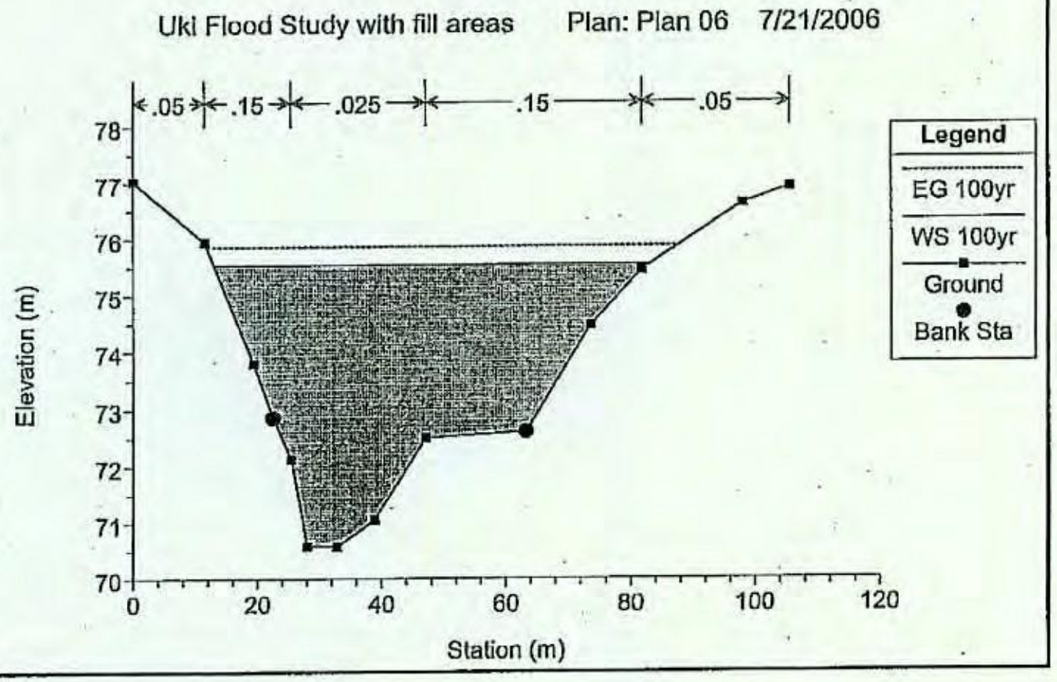
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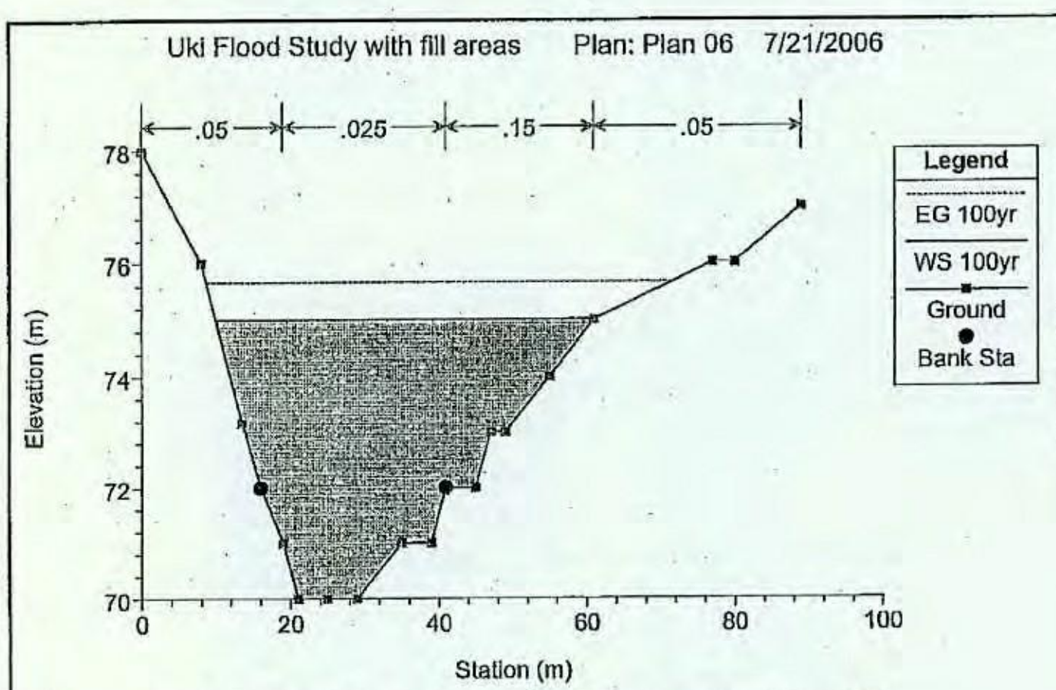
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Elevation (m)
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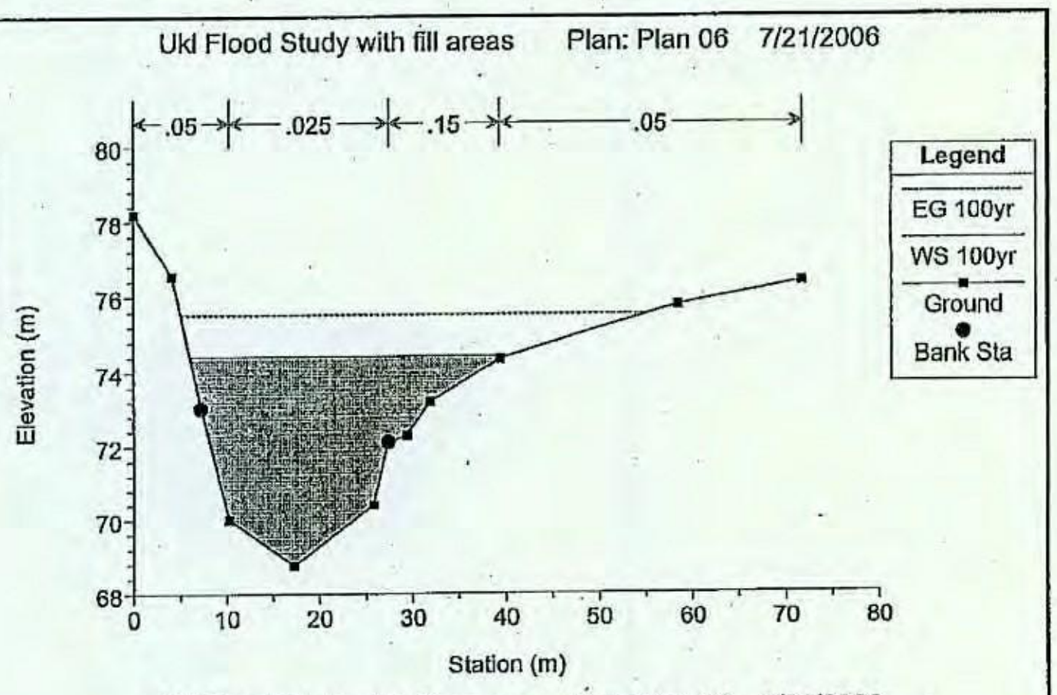
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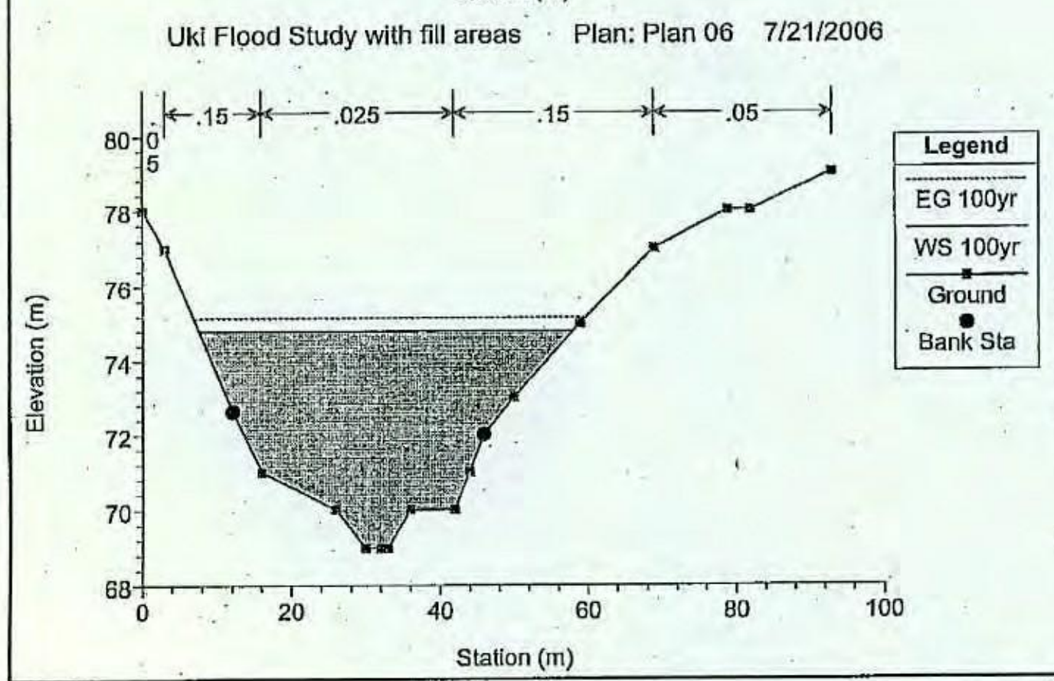
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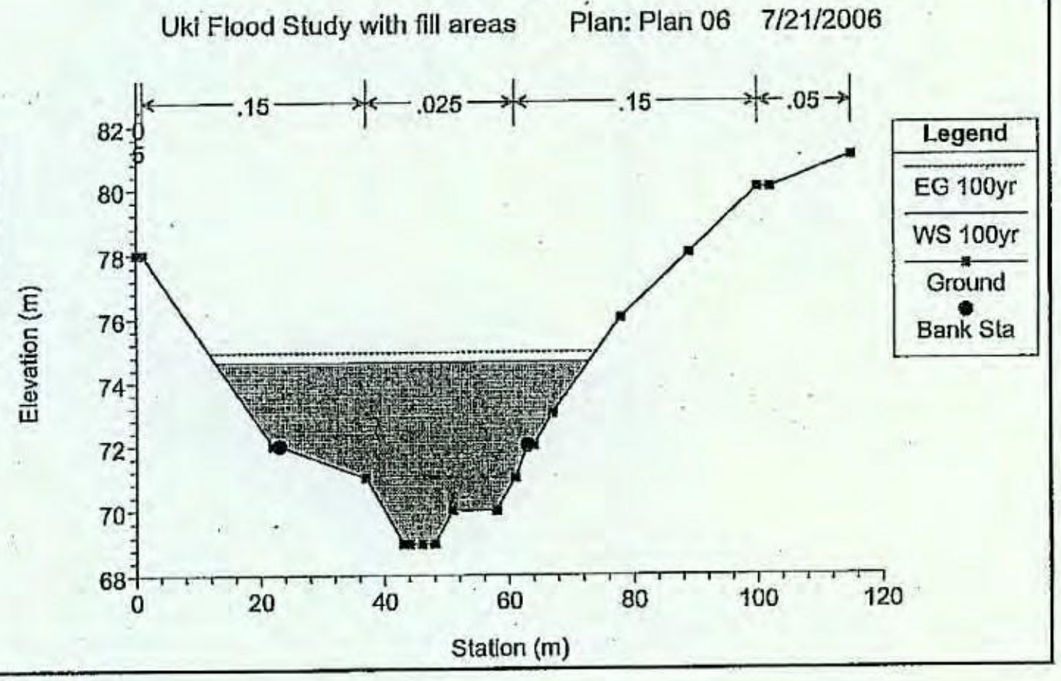
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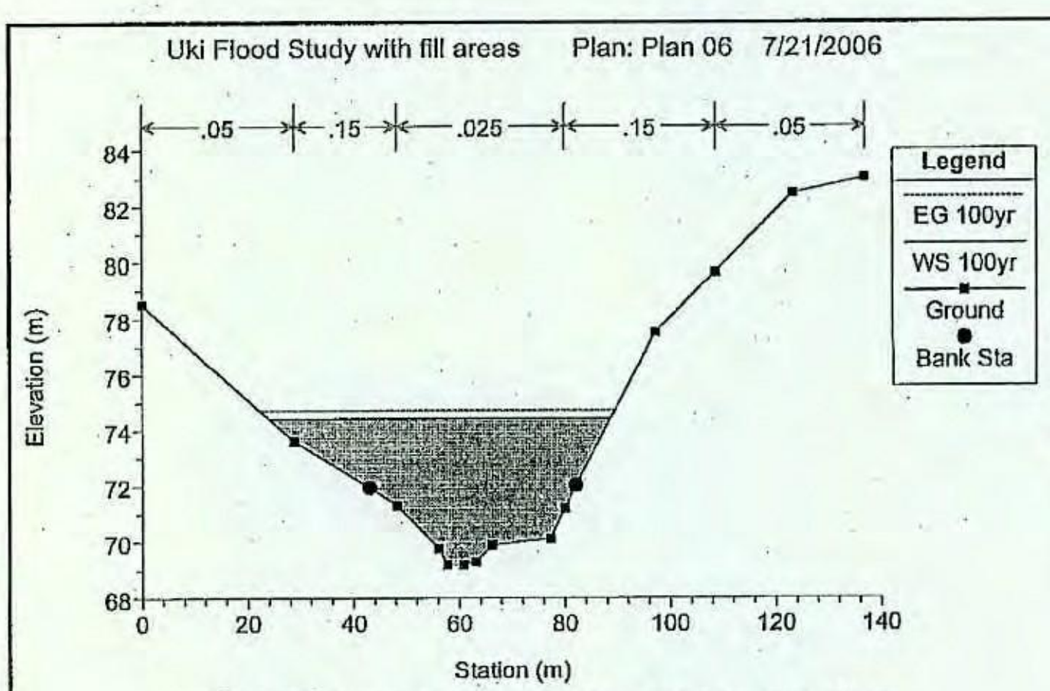
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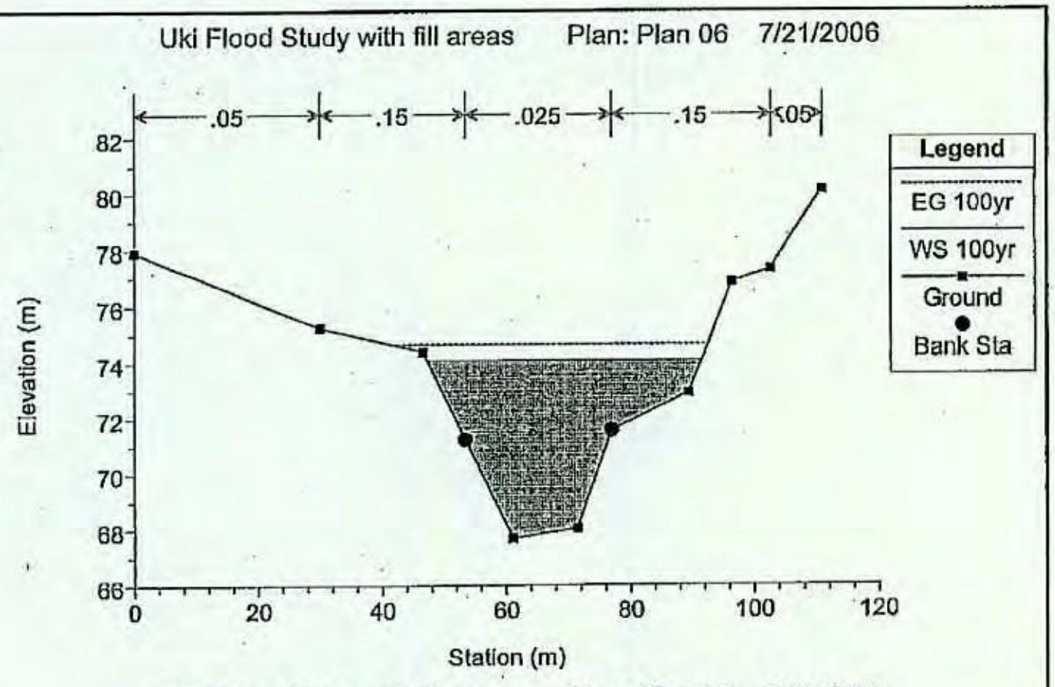
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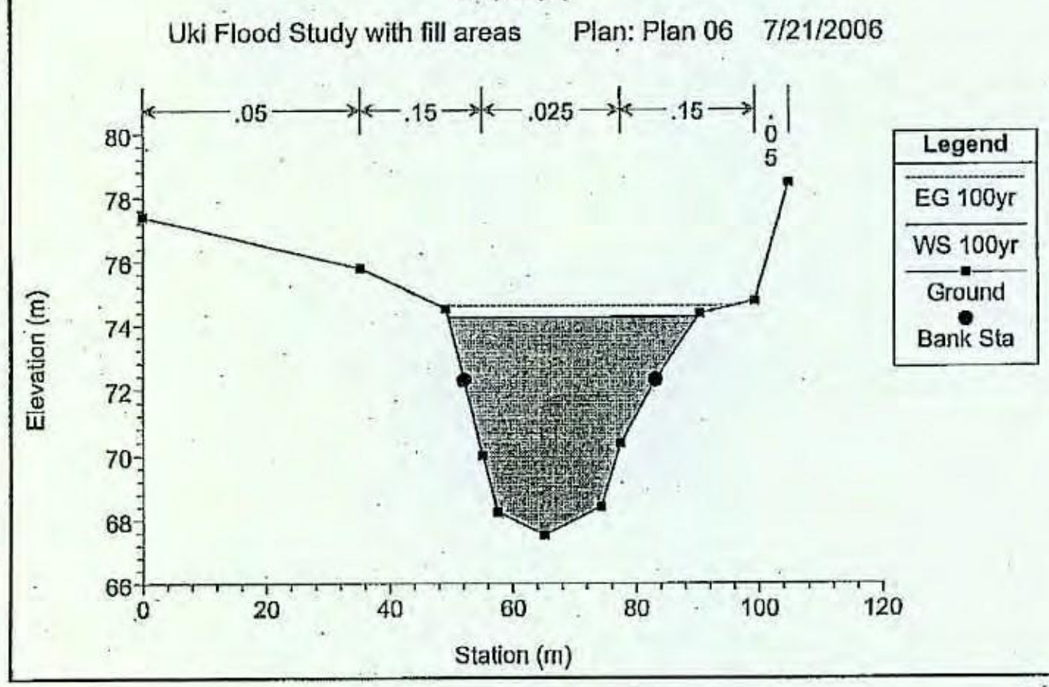
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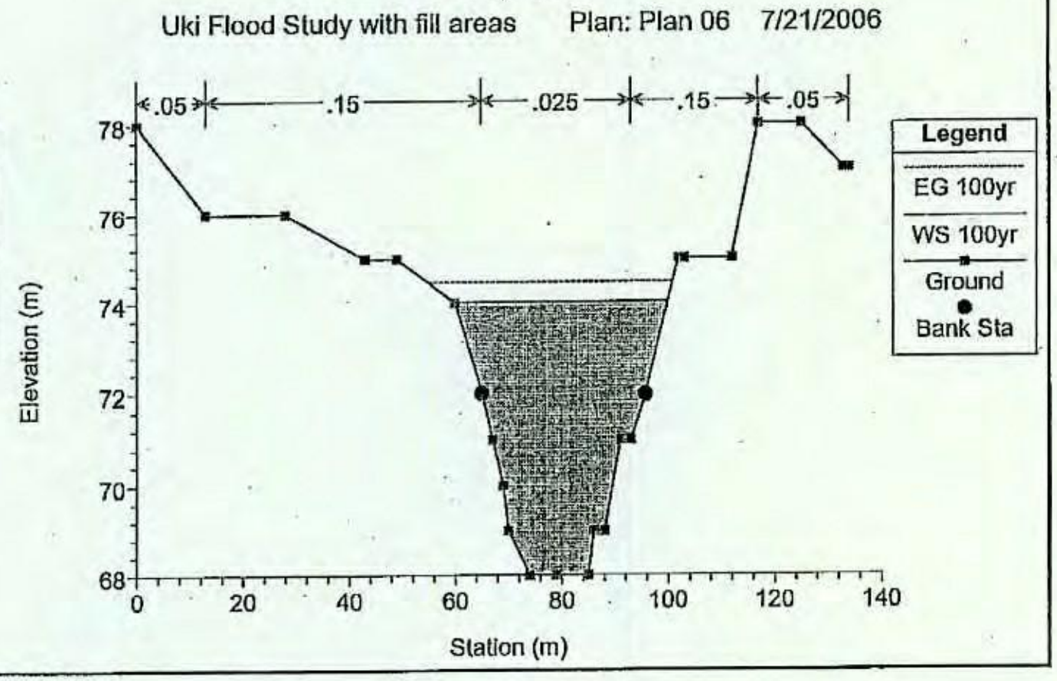
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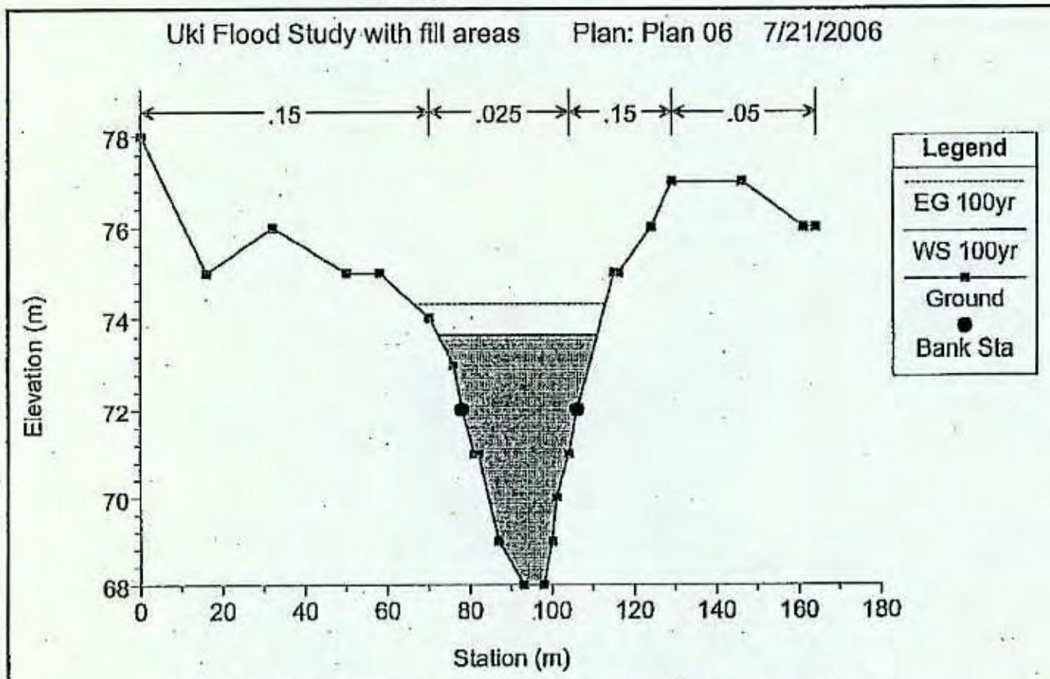
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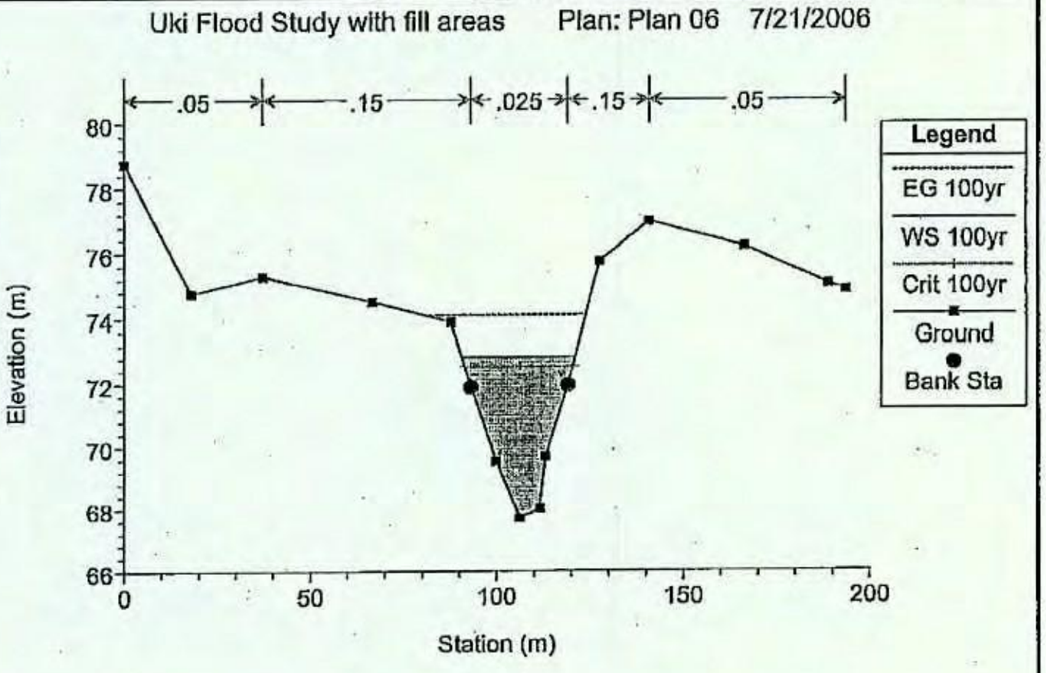
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Station (m)
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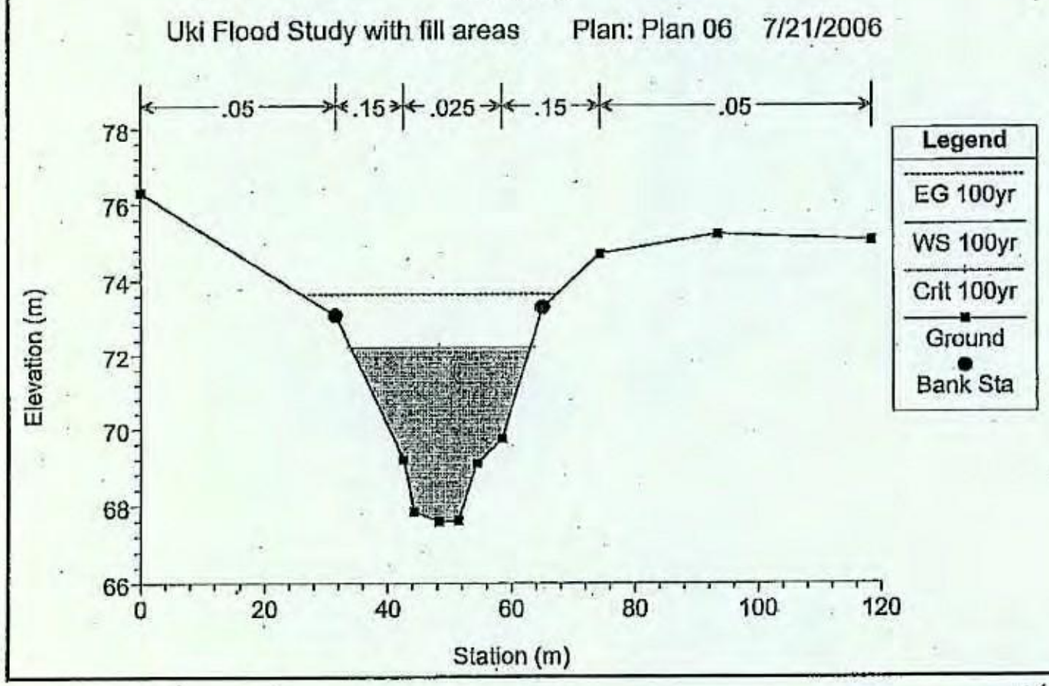
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